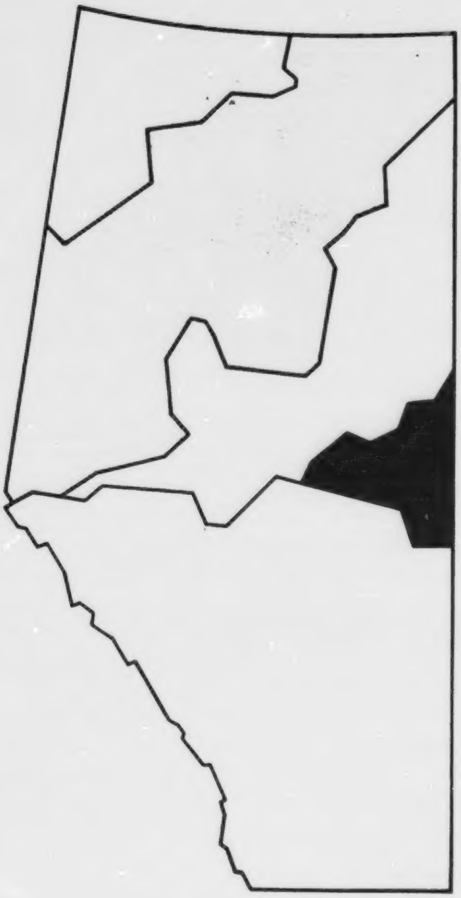

Water In Northern Alberta

Technical Report
December, 1987

Prepared for
The Northern Alberta
Development Council
by
The DPA Group Inc.
in association with
W-E-R Engineering Ltd.

Water In Northern Alberta

Technical Report

Prepared for:
The Northern Alberta
Development Council
Peace River, Alberta

Prepared by:
The DPA Group Inc.
Calgary, Alberta

in association with
W-E-R Engineering Ltd.
and
Environmental
Management Associates
Ltd.
Calgary, Alberta

December, 1987

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- All participants who provided generously of their time and energies in contributing to the interviews, focus groups, and workshops conducted during the course of the study.
- Ms Linda Beltrano, Project Director, and Mr. Gerry Archibald, Director, Research and Analysis, both on the staff of the Northern Alberta Development Council.
- Personnel of government agencies involved in water management who provided essential information on responsibilities, activities, programs and policies. Special thanks are extended to the staff of Alberta Environment who contributed to the study.

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Executive Summary

Background

Water resources and the proper management of those resources have long been identified as topics of interest and concern to residents of northern Alberta. In recognition of this interest, the Northern Alberta Development Council (NADC) sponsored a conference entitled "Water in Northern Alberta," held in Grande Prairie, November 4th to 6th, 1987. In order to initiate discussion of water resource issues prior to the conference and assemble background information to be used by conference delegates, NADC commissioned the conducting of pre-conference research, public consultative activities and the preparation of a conference Technical Report. This report represents the outcome of these assignments and the results of the conference delegates' deliberations.

Purpose of the Report

The report was used as a resource document for participants at the November conference. Key issues and preliminary suggested actions, as identified and put forward by northern residents, were described in order to provide a basis and starting point for deliberations at the conference. Furthermore, the report provided a wide range of background information useful in considering issues and in preparing for the conference working session. Background information includes historical background, roles of government agencies, and relevant technical information. At the conference, delegates worked with the issues and preliminary suggestions presented in the report, and developed a final set of suggested actions.

Pre-Conference Activities

Commencing in January 1987, a number of activities were carried out, culminating in the preparation of this report. These activities were carried out in two parallel tracks. One track consisted of a number of public information and consultation activities. The other track consisted of background research including review of existing briefs and reports and the preparation of technical assessments on topics of particular importance. The public consultation component consisted of interviews with key individuals knowledgeable in water issues, receipt of submissions from the public, the conducting of six focus groups across the north, and finally the convening of two large regional workshops in Grand Centre and Fairview. The background research component consisted of a review of NADC briefs and submissions, a review of key reports relevant to water in the north, and technical assessments carried out by subject specialists.

Water Resource Issues

Based on the public input received, a number of general topic areas were identified encompassing issues and concerns of importance to northern residents. These topics include: groundwater management; community water supply; farmland drainage and erosion; surface water quality; watershed and wetland management; farm and rural water supply; tourism recreation and fisheries; industrial water use; native people's concerns; and water diversion.

In general, the predominant concerns of northerners related to water are the protection of water quality and assurance of water supply. To achieve these goals northerners put forward a wide range of suggestions to the conference with a common focus on:

i) integrated planning of water and land resources;
ii) co-ordination of government activities and programs;
iii) increased monitoring of water resources and enforcement of land and water use regulations;
iv) improvements in public information and education;
v) furtherance of policy directions related to resource conservation;
vi) extension of research on basic and applied aspects of water management; and
vii) the need for augmented financial, infrastructure and manpower resources to achieve the above.

Conference Activities

Through workshops and small group sessions, the November conference effectively utilized the pre-conference information, refined and elaborated on the suggestions from the public consultation process, and developed a final set of suggested actions for each topic area and for the common themes described above.

1.0 Introduction

A primary mandate of the Northern Alberta Development Council (NADC) is the facilitation of public participation in the development of northern Alberta. One of the methods used to achieve this mandate is the sponsorship of conferences on topics of current relevance and importance to northerners. In the past 10 years, conferences have been held on a wide range of topics including transportation, agricultural land development, hardwood utilization, alcoholism, and tourism development. Water management has long been identified as an issue of concern and interest in the north. Approximately 15% of all briefs received by the NADC since 1973 have related in some way to water resources and their management. Water resources have emerged as important elements of several past conferences (Agriculture North, Tourism North, Challenge North) and are of vital interest to many NADC Councillors, local authorities and the public across northern Alberta.

Recognizing the importance of water resources to northerners, the NADC sponsored a conference entitled "Water in Northern Alberta," in Grande Prairie from November 4th to 6th, 1987. The conference allowed Council the opportunity to solicit advice, opinions and recommendations from private citizens, public groups, industry and government agencies on water-related topics. It was an excellent forum to document issues, views and recommendations of northern residents.

Given the broad range of issues related to water management, the complex regulatory and jurisdictional basis for government activity in water management, and the often complex technical nature of water resource issues, the Council saw the need for a general background document for delegates that would consolidate topical information to support discussion at the conference.

It was also considered desirable to commence public identification and deliberation of water resource issues well in advance of the conference so that the conference could focus on key issues with a good understanding of underlying factors.

In January of 1987, The DPA Group Inc. (DPA) was selected by the study Steering Committee and the NADC to assist in identifying water resource issues of concern to northerners and to prepare the Background Report for the conference. The report which follows hereafter represents the outcome of that assignment. In carrying out their work, DPA was assisted by W-E-R Engineering Ltd., Environmental Management Associates Ltd. and a number of specialist individual subconsultants. The specific activities carried out as part of the pre-conference project are described in Section 2.0 of this report. Public consultations consisting of interviews, focus groups and workshops were carried out across northern Alberta involving some 300 people. The work of the consultant team was guided by a Steering Committee composed of representatives of northern communities as well as provincial and federal governments. These representatives are identified in Section 2.0.

1.1 Purpose of the Report

The objectives of the pre-conference study and the overall purposes of this report are as follows:

i) To identify and document key issues relating to water and water management which presently affect or will affect northern Alberta
ii) To document the present status of water management programs and policies affecting water in Alberta with emphasis on the implications for northern Alberta
iii) To identify present and possible future water uses
iv) To identify constraints related to the development of future uses as noted in objective (iii)
v) To identify key potential policies and programs dealing with water management which would be beneficial and practical to northerners.

The Technical Report served as a resource document for delegates to the conference to use in preparing for working sessions. The report provides a clear linkage to these working sessions in that the organization of the report parallels the topics explicitly addressed at the conference.

The guiding approach taken in preparing the report was that it be "issue-driven." The input received from the public guided the topics addressed and the information presented. The report also identified, for each issue topic, a list of preliminary suggested actions that arose from the public consultation process. These suggestions were refined at the conference and the delegates prepared a final set of suggestions that were submitted to the NADC.

1.2 How to Use the Report

The report is organized in six sections:

1.0 Introduction
2.0 Pre-Conference Activities
3.0 Basin Overviews
4.0 Roles and Responsibilities of Government Agencies
5.0 Water Resource Issues
6.0 Common Themes

Section 2.0 describes the project activities that transpired between January 1987 and August 1987. It is recommended that readers interested in how issues were identified and how public input was utilized should review this section. The basic methodology leading to this report is described therein.

Section 3.0 provides a capsule narrative overview of the three river basins which are the geographic focus of the report. The intention of this section is to provide an initial familiarization with the natural characteristics of the basins (including land and water resources), the nature of human activity in the basins, and a brief overview of issues pertaining to water in the basins. It is recommended that all delegates read this section in order to obtain a comprehensive view of water resources in the north.

Section 4.0 provides an introduction to the roles and responsibilities of government departments and agencies which have mandates for water management or other functions related to the northern water resource. Since water is a public good, government has a large role to play in its management. The full contents of Section 4.0 may not be relevant to a specific reader's interests; it is suggested therefore that readers initially scan Section 4.0 to identify the departments and agencies with functions related to their concerns.

Section 5.0 provides a description of water resource issues as defined in the public consultation and background review components of the study. Ten issue topic areas were defined in order to group those concerns (as expressed by northerners) which had commonality in cause or effect. Within each subsection of Section 5.0, a separate issue topic area is presented in terms of:

i) **summary of the issue** — describing the nature of public concerns and the basic factors underlying these concerns;
ii) **background to the issue** — presenting information on the history of the issue, government roles and activities relevant to the topic, and technical information which might be useful in understanding the issue; and
iii) **key concerns and suggested actions** — contributors to the focus groups and workshops established rough orders of priority for concerns to be carried forward to the conference; participants also identified for each concern suggested actions which would be further considered by delegates to the conference. These suggestions were reviewed by delegates, refined or elaborated. Conference delegates' suggested actions appear in this report.

The issue subsections of Section 5.0 provided an information base to support the considerations of working groups at the conference. Readers are urged to absorb the contents of those issue subsections in which they have a particular interest. Readers interested in familiarizing themselves with a broader range of topics may wish to review all subsections in Section 5.0. Delegates were encouraged to discuss the identified issues, concerns and actions with friends and colleagues in order to obtain a broad perspective on the nature of concerns and on appropriate actions related to those concerns prior to attending the conference.

The following resource materials are provided in the appendices to this report:

i) Suggested Readings (Appendix A); and
ii) A Description of Terms, Units and Acronyms (Appendix B).

The suggested readings are provided as a means of exploring an issue beyond the confines of this report. The readings have been selected to be of a comprehensive nature, often providing a broader perspective of the technical, economic, social and environmental aspects of an issue. In most cases, the readings are readily available through the noted source or public library.

The description of terms and units is provided to familiarize the reader with standard metric measures used in describing the water resource. Comparative quantities and values are provided in order to make the standard metric units more readily interpretable.

Section 6.0 pulls together common themes which arose from the public consultation process. It is clear that a number of common elements of concern and similarities in suggested actions cut across the identified issue topics. These common themes were also the focus of discussion at the conference and delegates developed suggestions for action on each theme.

1.3 Study Area

The Terms of Reference for this study specified that investigations be carried out for the three predominant river basins in northern Alberta:

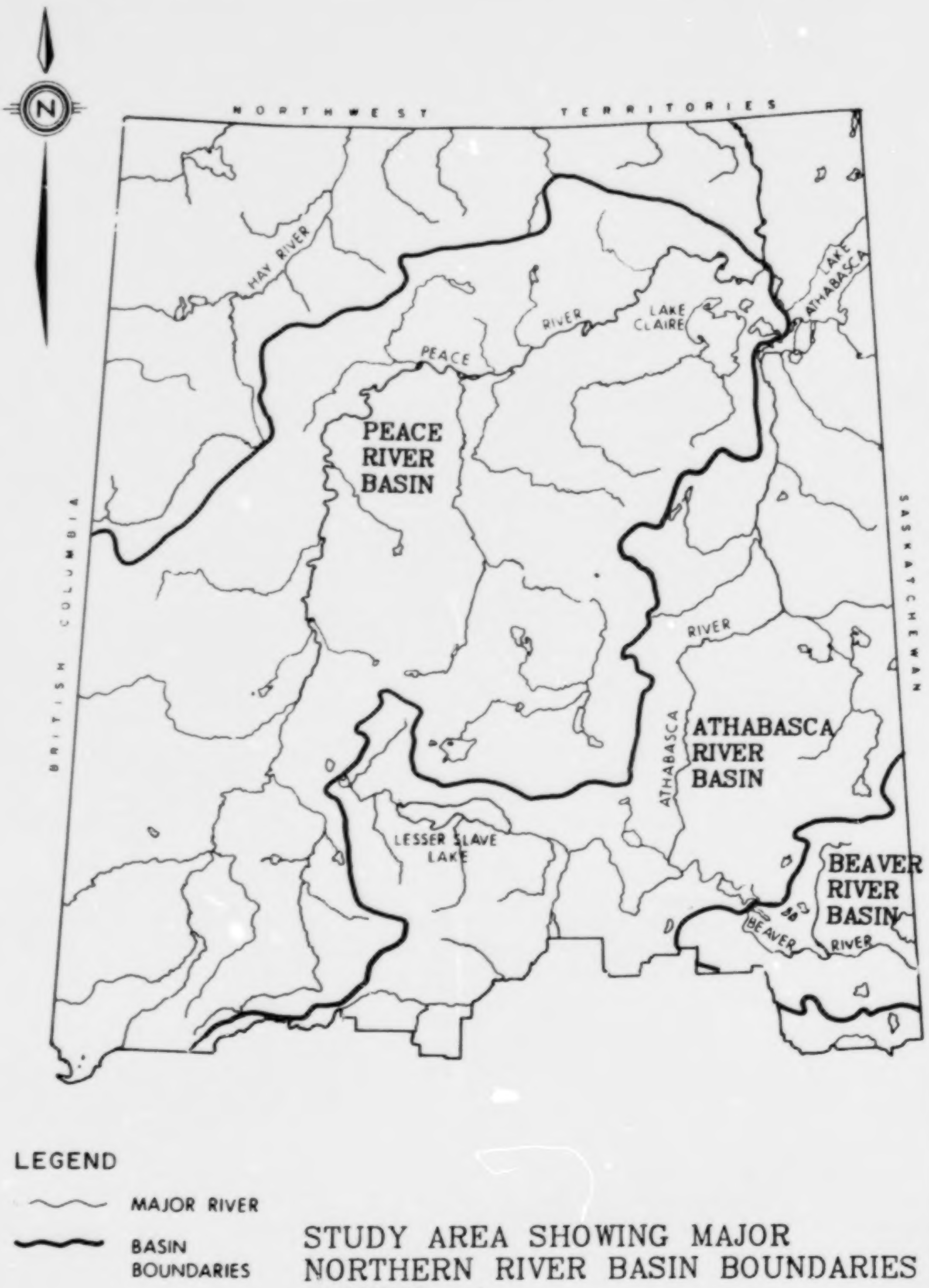
i) Peace River Basin
ii) Athabasca River Basin
iii) Beaver River Basin

The geographic boundaries of these basins are presented in Exhibit 1.1. Also shown in this exhibit is the NADC boundary.

The basin boundaries provide a clean definition of the study sub-areas. In a few instances, however, the boundaries divide generally defined socio-economic regions. Key examples include the separation of the McLennan/Kimiwan Lake area (Peace Basin) from the High Prairie/Winagami Lake area (Athabasca Basin) and the separation of Lac La Biche (Athabasca Basin) from lakes immediately south and east (Beaver Basin).

A substantial portion of the Athabasca Basin in the upper reaches lies outside of the NADC boundary. While public input from outside the NADC area was not solicited, effects of activities (principally forestry, coal mining and oil and gas development) in the upper reaches of the Athabasca will have effects upon downstream users. Where significant, these effects have been noted in this report.

There are several smaller basins or portions of basins at the northern boundary of the province (Liard, Hay, Buffalo, Slave and Lake Athabasca). While these basins do not support the extent of economic activity that the three major basins do, there are a number of issues in these basins that will likely parallel those identified in the major basins (e.g., surface disturbance, hydro-electric development, interjurisdictional arrangements). Where significant these issues have also been noted.


N
NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
HAY RIVER
LAKE ATHABASCA
LAKE CLAIRE
PEACE
RIVER
PEACE RIVER BASIN
RIVER
ATHABASCA
ATHABASCA RIVER BASIN
LESSER SLAVE LAKE
BEAVER RIVER BASIN
BEAVER
RIVER
LEGEND
MAJOR RIVER
BASIN BOUNDARIES

STUDY AREA SHOWING MAJOR NORTHERN RIVER BASIN BOUNDARIES
EXHIBIT 1.1

2.0 Pre-Conference Activities

As part of the year-long preparation for the November 1987 Water in Northern Alberta Conference, several activities were conducted culminating in the compilation of the Conference Background Report. These activities are listed in Exhibit 2.1.

Initial Steering Committee Consultations

The initial meeting with the Steering Committee and consultant team was held on January 6, 1987. The focus of the meeting was on confirmation of methods and general discussion of key issues.

The members of the Steering Committee are:

Robert Cronkhite, Water Resources Commission, Edmonton
Lynne Kemper, Water Resources Commission, Edmonton
Peter Melnychuk, Alberta Environment
Kevin O'Neil, Alberta Environment
Fred Gingerich, NADC, Athabasca
Don Appleby, Community Advisory Committee, Grand Centre
Warren Johnston, Mayor, Cold Lake
Alice Taylor, Community Health Nurse, Wabasca/Desmarais
Jim Peacock, Shell Canada Ltd., Peace River
Herb Wilcox, Farmer, Beaverlodge
Reg Adam, Prairie Farm Rehabilitation Administration (PFRA), Edmonton
Bob Walter, Mackenzie Regional Planning Commission, High Level
Fernand Turcotte, Councillor, MD of Smoky River
Linda Beltrano, Senior Northern Development Officer, NADC
Gerry Archibald, Director of Research and Analysis, NADC

The study was directed by Linda Beltrano.

The Steering Committee selected an approach using six focus group sessions and two regional workshops. It was decided that the focus group sessions would be held in Fort McMurray, Lac La Biche, Slave Lake, McLennan, Beaverlodge and High Level; the workshops would take place in Fairview and Cold Lake/Grand Centre.

Review of NADC Briefs

Some 221 briefs submitted to the NADC over the past five years were identified as having content broadly pertaining to water resources; briefs were selected using the computerized record-keeping system maintained by the NADC. Summary information on each brief was extracted. In conjunction with NADC staff, these extracts were reviewed and discussed in terms of validity (i.e., Did the briefs actually address water resource issues?) and topicality (i.e., Were the topics current in either a general or specific sense?). Where possible, the current status of an issue was noted. Very few briefs were classified as out-dated since the general topic was usually considered to be active even though a particular site-specific concern had been addressed.

The distribution of briefs by basin was as follows:

i)	Peace River Basin	102
ii)	Athabasca River Basin	72
iii)	Beaver River Basin	35
iv)	Other/Unclassified	12
		221

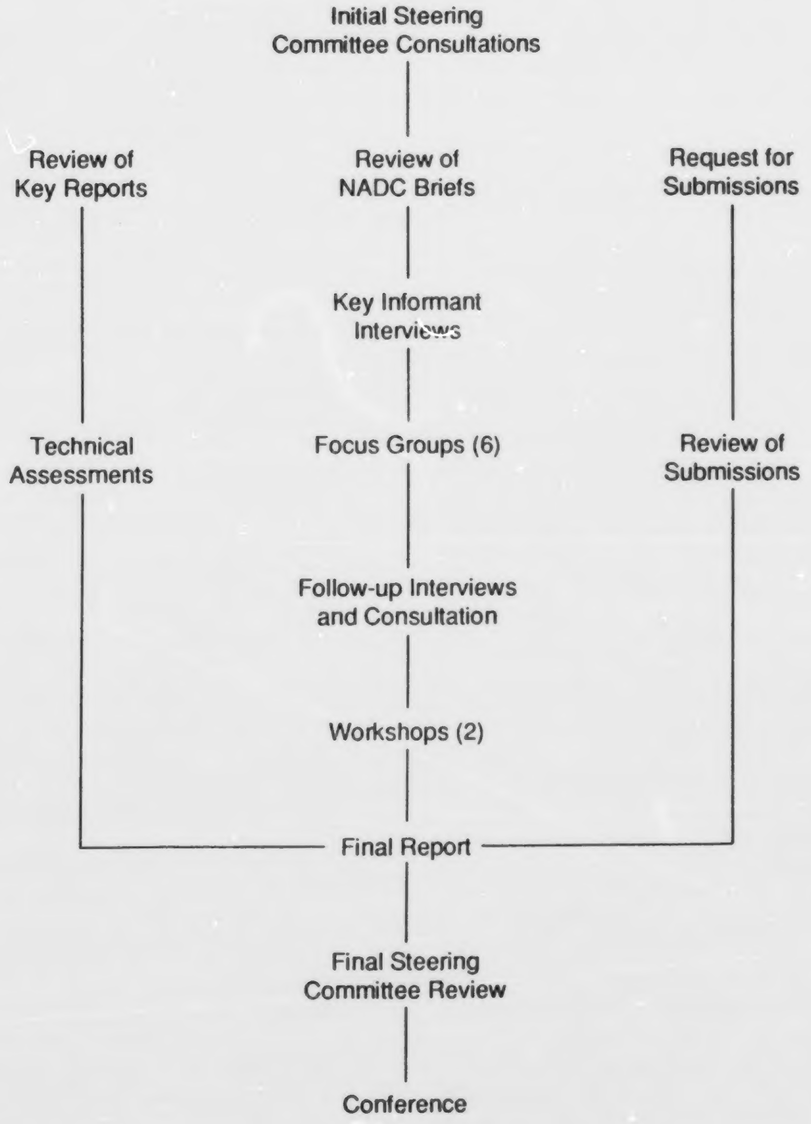
The briefs were classified in terms of five general topic areas:

i)	Agriculture	23
ii)	Industry (non-water based resources, e.g., forestry, coal, oil and gas)	13
iii)	Industry (water-based resources, e.g., trapping, commercial fishing)	17
iv)	Recreation, Tourism, Conservation	74
v)	Municipal/Domestic Water & Sewer	86
vi)	Other/Unclassified	8
		221

Briefs were typically presented in written or verbal format at public meetings organized by the NADC. The majority of briefs pertaining to water were presented by local government or organized groups although it was not uncommon for individuals to verbally record their views.

In a number of instances, briefs and associated files were selected for more detailed review. In general, these briefs were considered to have a greater depth of information related to current issues. The results of our review of briefs were consolidated for each basin.

Exhibit 2.1
Pre-Conference Activities


Initial Steering Committee Consultations
Review of Key Reports
Review of NADC Briefs
Request for Submissions
Key Informant Interviews
Technical Assessments
Focus Groups (6)
Review of Submissions
Follow-up Interviews and Consultation
Workshops (2)
Final Report
Final Steering Committee Review
Conference

Review of Key Reports

A number of comprehensive planning studies were reviewed for basic information on the water resource and for further identification of issues.

The following studies were particularly useful references:

- i) Identification of Water Resource Management Issues in the Athabasca River Basin (approximately 1980-81 Alberta Environment)
- ii) Peace River Basin — An Overview of Water Resource Planning Needs (1981, Alberta Environment)
- iii) The Cold Lake-Beaver River Water Management Study (1983, Alberta Environment and subsequent hearing documents)
- iv) Nature's Lifeline — Prairie and Northern Waters (1982, Canada West Foundation)
- v) Water Quality Overview of Athabasca River Basin (1985, Alberta Environment)
- vi) Peace River Basin Water Quality Review (1985, Alberta Environment)
- vii) Mackenzie River Basin Study Report (1981, Mackenzie River Basin Committee)
- viii) Background report on water management prepared by the NADC

Request for Submissions

Bob Elliott, Chairman, NADC sent introductory letters explaining the scope and purpose of the background study and follow-up letters inviting written or verbal submissions to elected representatives, local administrators and community leaders. As well, there were information and press releases inviting individuals to submit their opinions and concerns on water management in northern Alberta.

The list of people invited to submit their views was composed of: Improvement District Advisory Council Chairmen; Improvement District Managers; Mayors and Reeves; Regional Economic Development Council and Board Chairmen; Agricultural Service Board Chairmen; and Directors and Chairmen of Regional Planning Commissions. In total about 100 individuals were invited to submit.

Key Informant Interviews

Interviews were held with 41 key informants across the north. Emphasis was placed on interviewing representatives of local government and informed citizens. Individuals were selected on the basis of their knowledge of, and involvement with, water management issues. Others were selected based on a previously expressed interest in contributing to the study. Final selection was made by the consultant team in conjunction with the Study Director and with input from Steering Committee members.

The range of people formally interviewed was diverse, including farmers, an agrologist, elected representatives, sewer and water engineers, a forest superintendent, and native leaders.

A semi-structured interview guide was developed to ensure a reasonable degree of consistency in the scope and approach to interviewing.

Interviewees were asked to identify water resource issues, those issues which were important from their perspective and why. They were then asked for details of the issues such as the root causes and dimensions of the issues, the regions affected, the key groups or government agencies involved and gaps in public or private policies and programs. Interviewees were also asked to suggest any actions which would address the issue and to identify positive examples of effective programs and policies. Any technical questions and important sources of information or contacts were identified in the interview.

In all instances, respondents provided full co-operation and exhibited a sincere interest in contributing to the study. The results of the interviews provided a strong basis for identifying issues and concerns as noted in this report.

In addition to the interviews conducted with these key informants, information contacts were established with representatives of government departments including Alberta Environment, Alberta Agriculture, Alberta Municipal Affairs, and Alberta Forestry, Lands and Wildlife among others.

Focus Groups

In March 1987, verbal and written invitations were extended to individuals to participate in six regional focus group meetings across northern Alberta (Beaverlodge, McLennan, High Level, Slave Lake, Lac La Biche, Fort McMurray). Invitees included representatives of local government, the agricultural sector, economic development bodies, industry, Indian bands, Metis settlements, fish and wildlife associations, and tourism and recreation groups. The purpose of the meetings was to obtain perspectives on issues of regional or local importance.

The 82 participants reviewed and confirmed water management issues and concerns which were previously identified by the study team; additional concerns of the participants were also identified. The focus group participants were asked to establish priorities of listed concerns. The aspects of the concerns (i.e., policy, program delivery, funding, planning, regulation, research, resource inventory, information and education, institutional and public roles) and suggested alternative actions to resolve the concerns were discussed and recorded. Those concerns and suggested actions which the group wished to see carried forward to the conference were identified.

Concerns identified by the focus groups regarded topics such as: groundwater management; municipal/community water supply; erosion and drainage of agricultural lands; farm water supply; surface water quality/control of pollution from wastes and effluents; wetlands/shoreland management; watershed management/surface disturbance control; development of water-based recreation and tourism; industrial water requirements; program co-ordination, education and information; flood prevention; water diversion/interbasin transfer; and enhancement and protection of commercial fishing.

Review of Submissions

Detailed submissions of policy and program information were received from the provincial departments of Environment; Agriculture; Forestry, Lands and Wildlife; Municipal Affairs; Community Health; Recreation and Parks and from the federal Parks Canada; and Indian and Northern Affairs Canada. Information was also received from the provincial Energy Resources Conservation Board (ERCB). A summary was prepared of the programs related to water management in Alberta and the roles and responsibilities of the government agencies delivering the programs.

Written submissions to the project from community groups, local authorities and individuals were also received and reviewed.

These submissions added greatly to the comprehensive identification of issues.

Follow-up Interviews and Consultations

Follow-up interviews were conducted with native groups, contacts within provincial departments and other important contacts identified in the focus group meetings. More extensive government contacts were also established with emphasis given to the provincial Alberta Environment; Alberta Forestry, Lands and Wildlife; Alberta Agriculture; Alberta Transportation and Utilities; and the federal Indian and Northern Affairs Canada.

Technical Assessments

A list of technical questions arising from the focus group meetings was prepared by W-E-R Engineering and The DPA Group. The questions were directed to the appropriate provincial government departments.

Additional technical assignments (on groundwater, water quality, fisheries and wildlife) were reviewed and allocated to experts assigned as subconsultants to the core project team.

Workshops

A letter of invitation was sent out to approximately 300 individuals across northern Alberta for the regional workshops held in June. Approximately 50 delegates attended the workshop in Grand Centre and approximately 100 delegates participated in the Fairview workshop.

The primary goals of the workshops were to review, supplement and confirm water resource issues of importance to northerners, to exchange information and to address questions related to the issues. Another purpose of the workshops was to provide guidance to the conference organizers in terms of those topics that should be carried forward for consideration at the conference. The workshops were also used to initiate thought and discussion on practical solutions to water management problems and future directions for water management in the north. Key concerns and suggested actions were summarized by participants in 13 major topic areas.

Comments resulting from the workshops were then consolidated and incorporated into the Technical Report. The suggested actions from the workshops were addressed and modified by conference delegates. The final delegates' suggestions appear in this report.

3.0 Basin Overviews

Northern Alberta is rich in water resources. In fact, most of Alberta's surface water discharges flow through northern Alberta basins. But, as the following basin overviews will illustrate, the geographic distribution of water resources, including lakes, rivers and groundwater is highly variable both in quality and quantity. The northern half of the Province of Alberta is typified by the northward transition from agriculture to wilderness and by the contrast of industrial and subsistence economies. Water, however, remains common to all facets of northern life.

Northern Alberta is dominated by two river systems, the Peace and Athabasca Rivers, which join in a unique environment, the Peace-Athabasca Delta before contributing to the Mackenzie River system. Waters from both rivers eventually flow to the Arctic Ocean. Although discharges of the Peace and Athabasca Rivers comprise approximately 80% of all surface flows leaving Alberta, most of these flows originate outside Alberta. Both river systems transect the transition from the glacial till deposits of the Interior Plains to the exposed bedrock of the Canadian Shield.

Whereas the northern portions of Alberta's adjoining provinces, Saskatchewan and Manitoba, are dominated by the myriad lakes and rivers typical of the Shield, northern Alberta is characterized by relatively few dominant lakes and tributaries to the two major systems.

The Peace River system is characterized by the deeply incised Peace River valley drawing its headwaters and majority of flow from British Columbia. Tributaries are of limited volume and of highly variable seasonal flow, particularly in the northern half of the basin where precipitation is typically low. The upper Peace Basin represents a northerly remnant of the parkland ecosystem and is underlaid by silt and clay deposits of ancient glacial melt lakes. These soils support the extensive agricultural development of the south Peace area. Precipitation over much of the lower (or north) Peace area is relatively low and not dissimilar from parts of southern Alberta. The northern portion of the Peace River also establishes a demarcation in vegetation mix with aspen-black spruce forest to the north and aspen dominant forest interspersed with sphagnum bog to the south. The north central portion of the province, drained by the Wabasca River to the Peace, is characterized by flat terrain and muskeg. After confluence with the Wabasca River, the Peace descends through the Fort Vermilion Lowland before joining the Athabasca River waters flowing out of Lake Athabasca. At this point the two river systems converge to form the Slave River which drains into Great Slave Lake in the Northwest Territories.

The Athabasca River has its origins in the glaciers and snowmelt of the central Rocky Mountains. The upstream tributaries to the Athabasca arise from the eastern slopes of the Rockies, the highlands of the Swan Hills, and the rich agricultural areas of the Paddle and Pembina Rivers. Lesser Slave Lake acts as a huge holding reservoir releasing flows gradually to the Athabasca before it tumbles through a series of rapids in the Thickwood Hills to the confluence with the historically rich Clearwater River. At this point, the river becomes broad and navigable to barge traffic all the way to Lake Athabasca. The upper Athabasca Basin receives the greatest annual precipitation in all of Alberta, contributing to flooding in the rivers flowing north out of the Swan Hills as well as the Paddle and Pembina Rivers.

The Beaver River Cold Lake Basin drains eastward in the Churchill River system and eventually to Hudson Bay. The basin is unique in its abundance of high quality lakes and localized arable soils. The distribution of petroleum resources has impacts upon all parts of the north and the Beaver River Basin in particular.

The following sections provide a brief overview of each of the study basins.

3.1 Peace River Basin

Water Supply

The Peace River Basin (including the Peace-Athabasca Delta) is the largest river basin in Alberta, draining approximately 200 000 km^2. The average annual discharge of the Peace River at Peace Point is approximately 2 000 m^3/s, but over two-thirds of this flow originates in British Columbia and is highly regulated by the W.A.C. Bennett Dam. Over the period of record, 1959-1984, the minimum and maximum annual discharges at Peace Point were 1 100 m^3/s and

2 800 m^3/s, respectively. The distribution of water in the Alberta portion of the basin is unbalanced, with the large supplies concentrated in a few major rivers. Many smaller streams in the Peace River area dry up almost completely at some time during most years. Among Alberta tributary basins, the Smoky River sub-basin shows the best year-round water supply potential.

Knowledge of groundwater availability in the basin is incomplete. Reconnaissance studies and more detailed investigations around communities suggest a low level of availability over much of the basin, except in a few localities where significant groundwater quantities are found in buried sands and gravels (e.g., near Utikuma Lake, Bistcho Lake, Hythe/Sexsmith, and Berwyn/Grimshaw areas).

The number of stations recording surface water flows in the Peace River Basin is relatively small, and only major streams are monitored. Meteorological data is even more sparse.

Supply/Demand Considerations

In general, there are few supply/demand problems in the basin, primarily because of the low level of demand relative to the generally abundant supply. The pulp mill near Grande Prairie alone accounts for about three-quarters of the total water consumption in the basin, yet its withdrawals represent less than 0.1% of the lowest daily flows in the Wapiti River (the source of its water supply).

The majority of communities in the basin (87%) rely on surface water as a source of supply. The two large centres of population, Grande Prairie and Peace River, should have an adequate quantity of water supply for several decades at least. Several surrounding communities, however, have required emergency pumping of water in some years, and any significant increase in demands will result in more serious problems for a number of towns. A regional distribution line may eventually be required for a number of communities in the Wanham-Spirit River area. A recent report on water supply to northern communities (Northwest Hydraulic Consultants Ltd., 1983) established a basis for consideration of this question.

There is some concern that drainage development in agricultural parts of the basin may affect both groundwater levels and base flows in local streams. This, in turn could affect municipal and domestic water supplies. Unfortunately, it is difficult to anticipate the extent of impact without further study.

Industrial water is largely self-supplied from surface water sources. Significant development of the Peace River Oil Sands will most likely rely on the Peace River for major withdrawals. Development of the Wabasca deposits may experience some shortage of convenient supply, depending on the location of development. Groundwater demand for oil field injection may increase with more intense development, but demands in a given field generally decrease over time as the use of produced water increases. Concern has been expressed over the effects of groundwater withdrawals on future domestic and municipal supplies in both the Hythe/Sexsmith and Grimshaw/Berwyn areas.

Future forest products industries in the basin are not expected to have supply problems; and potential pulp mills would most likely locate near the Peace River. Development of a steel industry would not likely be constrained by water availability.

Hydro development in the basin has been investigated in the past. Three potential sites have been identified for the Peace River (Dunvegan, Peace River Gorge, and Vermilion Chutes) and hydro development potential also exists in the Smoky and Wabasca River Basins. The Peace River developments would have a minor impact on the river individually, as they are largely run-of-the-river projects, but the cumulative impact of several projects on flow patterns could be significant. In particular, the Peace-Athabasca Delta might be adversely affected by altered flow regimes. The delta was seriously affected from reduction in the flow of the Peace River during the filling of the Williston Lake Reservoir in British Columbia, and new developments, such as Site C in British Columbia, could again prove harmful. Additional concerns relate to the effect of water releases on ice conditions and the geotechnical stability of the river valley. Barging in Lake Athabasca and through channels to the Athabasca River could also be affected. The report of the Peace-Athabasca Delta Implementation Committee is to be released in the coming few months. The report will set out the flow management regime which has been determined to be acceptable to all parties, including consideration of environmental effects. Development of a hydro dam on the Slave River, which drains both the Peace and

Athabasca Basins, could also have significant impact on water levels in the delta. The environmental impacts of the Slave River hydroelectric development were assessed in feasibility studies carried out roughly between 1979 and 1984. Development of Slave River sites has however been indefinitely delayed as a result of weak energy demand.

Provincial government policy stipulates that "water in each major basin must be fully and efficiently utilized before inter-basin augmentation could be considered" (Water Resource Management Principles for Alberta, Alberta Environment, undated). Although the technical feasibility of diverting water from the Peace and Athabasca Rivers south has been examined at a cursory level (e.g., the Saskatchewan-Nelson Basin Board (SNBB 1972) described two possible diversions totalling 550 cms, about 25% of the average annual flow of the Peace River), this policy indicates that such diversions will not be considered in the foreseeable future. Projects to divert water from the Peace River to southern Alberta would adversely affect the economic viability of potential hydro projects downstream on the Peace, and could ultimately limit other economic developments in the basin. They might also have serious environmental consequences, especially in the Peace-Athabasca Delta, and possibly downstream in the Mackenzie River Basin. Studies of diversion to date have not given any detailed consideration to cost, environmental or social impacts.

Unfortunately, the Peace River Basin contains few lakes and streams suitable for recreation near areas of high population. Concerns have been identified as to the need for enhancement of lake-based recreation in the basin. The Wabasca Basin shows the greatest potential for sport fishing and recreational development. There is potential for some fisheries habitat improvement or development projects. Concern has also been expressed about how fluctuating water levels caused by hydro development on the Peace may affect recreational use of the Peace River Valley.

Management of wetlands and marshes has a direct influence on the habitat of many furbearing animals, ungulates and waterfowl. Utikuma Lake has been identified as a sensitive area by the Mackenzie River Basin Committee, a federal/provincial/territorial committee assisting in research and planning for the Mackenzie River (see Section 4.4). The lake provides important waterfowl habitat. Elsewhere, land drainage projects have the potential to remove significant amounts of wetlands habitat. Wetland habitat inventory work is currently being conducted as part of water management planning in the Peace River Basin.

Water Quality Considerations

In general, the natural surface water quality in the Peace River Basin is good. Many lakes, however, suffer low dissolved oxygen concentrations in winter, making them unsuitable as fish habitat. Groundwater quality varies from good to unpotable. In broad terms, it is best in the western part of the basin and in shallow aquifers.

The pulp mill on the Wapiti River is the source of the most prominent surface water quality concern in the basin. Mill effluent affects the quality of water as far downstream as the Town of Peace River. There are concerns regarding the effects of effluent on aquatic life. The Town of Peace River moved its water supply intake upstream of the confluence of the Smoky and Peace Rivers in an effort to avoid use of Smoky River water.

Another industrial activity that is viewed as a potential threat to water quality is the deep-well disposal of wastes from oil production projects. Though the wastes are injected at great depths, there is a concern that over time they could contaminate aquifers used for domestic water supply. At the present time, extensive background research is being conducted by Alberta Environment and Alberta Research Council.

Timber harvesting, agricultural runoff, and land drainage have the potential to increase sediment loads in local streams as a result of increased erosion. Agricultural runoff can also add fertilizers, herbicides and pesticides to local water bodies.

Overall, water quality information for the basin is very limited, though near-natural conditions prevail through much of the basin. More detailed basin data would be useful in assessing the potential impact of future projects.

Drainage and Erosion of Agricultural Land

Historically, the opening of forested lands for agricultural development in the Peace Block led to the demand for drainage improvements. It has been recognized that implementation of drainage projects improves agricultural production, but has negative impacts in terms of loss of wetlands habitat, flooding of lower agricultural lands downstream, and costs to correct the erosion damage to the transportation network, receiving streams and farms.

In 1975, the Agriculture Service Boards in the Peace Region petitioned the Alberta Government to thoroughly investigate the drainage erosion problem. As a consequence, in 1976 the Environment Council of Alberta (ECA) conducted a research program together with a series of public hearings. In 1978, an *Interdepartmental Action Plan on Erosion Control in Northwestern Alberta* was released, in response to the recommendations in the ECA's final report. The Action Plan essentially formed a blueprint for a co-ordinated approach to monitor, plan and fund erosion control projects.

As a result, a number of erosion projects and government activities have taken place. There is also a growing awareness at the municipal government and agricultural level of the importance of erosion control.

Considerable demand has been noted for the implementation of drainage and erosion control projects, both on-farm and off-farm. Programs have been developed to enable projects to be designed and implemented, but funding shortages have prevented massive implementation. As well, there is growing awareness among municipal and provincial governments of the need for the development of a sub-basin planning tool by which landowners, administrators and politicians can identify, evaluate and plan for the environmental effects of rapid drainage.

Such a tool would facilitate the co-ordination of activities and implementation of drainage, erosion control and habitat protection in a planned logical manner. At present sub-basin water management plans are being developed by Alberta Environment for selected areas in the northwest. These sub-basin plans are in the early stages of development and are seen by all parties involved as an important method of priorizing implementation of programs on a local level. Hence, continued development of these plans is in itself a priority.

3.2 Athabasca River Basin

Water Supply

The Athabasca River Basin is the second largest in Alberta, draining 157 000 km^2. The average annual flow near its mouth at Lake Athabasca is nearly 800 m^3/s. Minimum and maximum monthly summer flows range from about 400 m^3/s to nearly 2 800 m^3/s. The river system is largely unregulated, except for some flood-control structures on upper tributaries and stabilization of Lesser Slave Lake. Ice-jam flooding is a major concern at Fort McMurray. The number of lakes in the basin is rather limited, but includes several areas of high recreational capability.

Groundwater is generally available upstream of the Athabasca's confluence with the Lesser Slave River, though production is low in some areas. There is also some groundwater in the Fort McMurray area and a band of high-yield underlying the Athabasca River north of Fort MacKay.

Surface water data collection covers the whole basin, but sparsely. The network of meteorological stations is similarly sparse, so a detailed description of climate is difficult.

Supply/Demand Considerations

Water use for oil field injection constitutes the largest category of water consumption in the basin. This use is concentrated in the Judy Creek-Swan Hills and West Pembina fields. The amounts consumed are relatively small, however, and water supply, either from surface water or groundwater sources, is not expected to limit oil and gas development in the basin.

The greatest water supply concern in the basin is related to the production of synthetic crude oil from the Athabasca Tar Sands downstream of Fort McMurray. At present, withdrawals amount to less than 1% of the lowest annual flow in the Athabasca River, but a level of oil production of one million barrels per day could require up to 10% of the lowest monthly flows experienced in the river.

Other industrial water demands are small relative to available supplies in most areas. Intensive coal development in the Cadomin-Luscar-Mountain Park area is expected, but water supply is not expected to be a problem. There is a remote possibility of a coal slurry pipeline from this area, but water could be easily supplied from the Athabasca River. There are no hydro or thermal power developments in the basin, and none have been proposed.

Urban water supply in most areas is assured. Farm water supply is in particular abundance in the Pembina and Paddle River Basins. As in other areas of northern Alberta, there are a number of smaller and remote communities where ongoing needs for sewer and water upgrading have been identified. There are particular needs in hamlets which have a limited tax base, in areas of unorganized settlement, and in native communities.

A number of excellent recreational lakes are found in the Lac La Biche and Lesser Slave Lake Sub-Basins. Considerable emphasis is being placed on the use of these lakes as tourism generators. The Clearwater River has historic and recreational significance as a river that has remained almost unchanged since it was used as a major trade route during the height of the fur trade. The rest of the basin presents a wide range of river canoeing opportunities but few quality recreational lakes in proximity to population centres.

The west end of Lesser Slave Lake has been identified as a sensitive area by the Mackenzie River Basin Committee. The Buffalo-Bay-Horse Lakes area is part of an ecologically rich delta created by the East and West Prairie Rivers. It is extremely important to wildlife and fisheries production and depends on natural water regimes and lake levels. A number of water control structures have been built in the area to stabilize lake levels and supply local communities.

Commercial barges operate on the Athabasca River between Fort McMurray and Lake Athabasca. Dredging is needed at the mouth to assist barges into the lake. At present, dredging is not adequate to maintain safe navigation during low-flow periods. Increased mineral exploration and development could place additional demands on this transportation system. Lake Athabasca supports an active commercial fishery and there are demands for infrastructure (docks, breakwaters) to support this activity.

The potential for diversion of water from the Athabasca River remains as a concern in the area. Diversions of up to 50% of the high summer flows of the Athabasca River to southern basins have been described by the Saskatchewan-Nelson Basin Board (SNBB, 1972). Were such diversions to be implemented, they could create supply/demand problems in the basin far beyond those presently projected. Any such proposal would require a thorough examination of potential effects on other developments, the basin's ecology, navigation, etc. As noted earlier, current provincial government policy stipulates that the "waters in each major basin must be fully and efficiently utilized before inter-basin augmentation could be considered" (Alberta Environment, 1983).

Economic development scenarios have recently been completed for the Athabasca River Basin. Alberta Environment is now in the process of developing water-use scenarios based on the projections of economic development. The water demand projections will enable a much better determination of any supply/demand problems that might be anticipated. Alberta Environment is also working on a number of lake management plans in the basin.

Water Quality Considerations

A Water Quality Overview of Athabasca River Basin (Nanuk Engineering Ltd., 1985) was recently completed for Alberta Environment. The report described major water quality patterns and trends for the Athabasca River and its major tributaries. Unfortunately, long-term water quality data were quite limited. The report recommended that additional monitoring data be collected at several locations in the basin.

Results of the water quality overview indicated that, except for the pulp mill at Hinton, point source effluents from municipal and industrial plants have no broadly-based influence on river quality. In almost all instances, tributary streams account for 90% or more of all measured constituent loadings. The Hinton pulp mill affects Athabasca River water quality particularly during low-flow periods in the fall and winter. Elevated levels of organic compounds, bacteria, and color have been found for a distance of 50-75 km downstream of Hinton. These levels remain within government standards. Coal mining activities in the upper Pembina and McLeod Basins do not have a detectable impact on either river or on the mainstream of the Athabasca River. The report identified a potential for problems with tailings impoundments and waste-rock disposal and suggested that future development be monitored to establish the extent of any impact.

In the middle reaches of the Athabasca River, between Fort Assiniboine and Fort McMurray, changes in water quality are due mainly to the inflow of many tributaries, including the Pembina, Lesser Slave, and La Biche River. No major man-made pollution sources have been detected along this reach of the river, but concerns have been expressed about the use of insecticides for black-fly control in the area. Runoff from agricultural and oil industry developments has apparently increased siltation in the Lesser Slave Lake Basin. Concerns have been expressed about the decline of fishery populations in the Lesser Slave Lake and the possible relationship of this decline to aquatic habitat changes among other factors.

Discharges from the oil sands plants below Fort McMurray are reported to have an influence on the river water quality. Normal discharges include both process effluent and mine depressurization water. Accidental discharges (e.g., failure of a holding pond dyke) could significantly decrease water quality. Naturally occurring bitumen that washes into the Athabasca River is reported as not posing a threat to fish populations.

Trace organic loadings related to tar sands development were not considered in detail in the water quality overview. These could have impacts on downstream users and aquatic organisms, but it is not clear how much the projects themselves are contributing to the loading. It is recognized that further work is required to resolve this question. Routine discharges from vessels (barges) are not of sufficient volume to have any measurable effect on water quality.

In general, the overview report stated that Athabasca River water can be used for all beneficial uses except contact recreation, which is limited much of the year by low water temperatures and high turbidity. Certain objectives for aquatic life and wildlife are occasionally exceeded, but these conditions are reportedly due to natural causes and not thought to be significant. Northern residents have ongoing concerns regarding the use of methoxychlor in the Athabasca River for blackfly control and the cumulative effects of pulp mill and oil sands development on river water quality.

In the Barrhead-Westlock area and the County of Athabasca substantial areas of peatland are either being drained or being considered for drainage to allow cultivation for agriculture.

A specific concern in the Athabasca Basin has been flooding of Fort McMurray attributed to ice-jamming. Floodplain management consisting of zoning, mapping and engineering design has been initiated to address the problem.

3.3 Beaver River Basin

Water Supply

The Beaver River Basin is one of the smallest basins in Alberta (22 000 km^2), but it contains nearly one-half of the province's high capability recreational shorelands. The average annual flow of the Beaver River near the border with Saskatchewan is 27 m^3/s, while the minimum and maximum recorded annual flows are approximately 10 m^3/s and 60 m^3/s. The discharge from Cold Lake accounts for another approximately 17 m^3/s. Cold Lake has a surface area of 350 km^2 extending into Saskatchewan. The Beaver River forms the headwaters of the Churchill River system.

Most of the groundwater in the basin has just undergone extensive study by Alberta Environment (see the Cold Lake-Beaver River Management Study, Alberta Environment, 1983). Hydrologic data bases for both surface and groundwater have been developed, and models have been formulated to help define available water resources. More detailed groundwater analyses have recently been completed and withdrawal limits are being set for specific groundwater aquifers.

Baseline water quality data has also been collected for the basin and the level of biological productivity of lakes has been defined. Water quality models have been developed for streams and lakes in the basin.

Supply/Demand Considerations

Water supply for oil sands development in the Beaver River Basin has been a major concern for a number of years. Under assumptions of high levels of industrial development, the amounts of water required by projected developments are significant relative to locally available supplies. Residents have expressed concern that lake levels and streamflows would be reduced to the detriment of important fish and wildlife habitat in the region. This, in turn, would reduce the recreation and tourism potential of the basin.

In 1985, the Government of Alberta adopted a long-term water management plan for the basin, with the result that pressure on local supplies has been greatly reduced. The Cold Lake-Beaver River Water Management Study, which provided the basis for the plan, was a comprehensive effort to examine technical and socio-economic aspects of water management in the basin. After reviewing several management alternatives on the basis of cost, impacts of water quality, recreation and fisheries, reliability of supply, and public acceptability, the government has specified that:

i) all major oil sands plant withdrawals will be supplied by a single-source pipeline from the North Saskatchewan River;

ii) all municipal, agricultural, non-oil sands industrial, and minor oil sands industrial withdrawals are expected to be met from within the basin, but surface water withdrawals will be limited to the Beaver River and specific lakes;

iii) groundwater withdrawals will be allowed on a site-specific basin within a maximum use limit; and

iv) no withdrawals will be allowed from May, Manatokan, Muriel, Reita, and Tucker Lakes as they are to be managed for the purposes of conservation, fisheries, wildlife and/or recreation.

It is anticipated that the pipeline will provide for an adequate water supply to meet long-term industrial demands, thus assuring local supplies of surface and groundwater for other demands as well. At the present time, non-industrial water demands (e.g., municipal, domestic, agricultural) tend to be overshadowed by industrial requirements in the basin. As in other parts of northern Alberta, there are ongoing requirements for upgrading of community sewer and water systems, particularly in centres of high growth. There may still arise some concerns related to lake levels in lakes used for recreation (e.g., in the upper portion of the basin), but no major supply problems are foreseen.

Water Quality Considerations

Water quality in the Beaver River Basin is generally good. Most lakes are naturally productive and still in their natural state. Most streams are relatively unaffected by development. Marie and Muriel Creeks have slightly lower quality due to municipal waste discharges and agricultural runoff. Dissolved oxygen concentrations in the Beaver River are low in winter which may be harmful to fisheries.

With the projected oil sands development in the basin, concern was expressed that water quality would diminish with increases in municipal and industrial waste discharges. The government's long-term plan specifies that no surface discharge of in situ oil sands recovery or upgrading process waste-water will be allowed in the basin. These industrial waste effluents will be disposed to deep wells, or treated and reused. Alberta Environment has committed to undertake detailed studies in order to establish the future limits of deep-well disposal and to ensure that future industrial waste-water volumes disposed by deep-well injection do not exceed these limits.

Alberta Environment will continue to work with the municipalities to ensure that waste-water discharges do not exceed allowable loadings. Industrial water users will be encouraged to make further use of municipal or other effluent to reduce consumption of fresh water and to reduce the amount of effluent being discharged into the Beaver River system. The water supply pipeline will be a closed system to eliminate concern over transfer of fish species and organisms into the Beaver River surface waters.

4.0 Roles and Responsibilities of Government Agencies

Water is a public good, which is to say that the ownership and responsibility for managing water in Canada resides in government. Under the Canadian constitution, ownership of public lands, mines and minerals is vested in the provinces. Although no mention was explicitly made of water in the constitution, the provincial ownership of public lands has been interpreted to apply to rivers, lakes and other watercourses, excepting those waters occurring on federal lands. The constitution gives further jurisdiction to the provinces over local works (including electricity generation) and all matters of merely local or private nature. In short, the provinces have the authority through provincial legislation for a wide range of water management activities including:

i) licensing and allocation of water use;
ii) licensing and regulation of engineering works affecting water;
iii) protection of water quality; and
iv) water resource investigations and planning.

The federal government retains sole or shared jurisdiction in a number of areas including:

i) fisheries;
ii) navigation;
iii) relations with foreign governments; and
iv) federal lands (Indian reserves, national parks, northern territories).

The purpose of this section is to provide an overview of governmental roles, responsibilities and activities related to legislated mandates in water management.

Given the pervasive roles of governments in managing the water resource, and the importance of these roles in the issues to be discussed later in this report, it is important to obtain an appreciation of who is doing what in water management.

In the sections which follow, the functions of departments and agencies of the Government of Alberta, local authorities in the province, and the federal government are reviewed. Lastly, joint federal-provincial activities are reviewed. For the reader interested in more detail on the constitutional and legal basis for division of authority in water management, the Final Report of the Inquiry on Federal Water Policy (1985) is suggested as a useful source.

More detailed descriptions of the water-related activities of Alberta provincial government departments may be found in the annual reports for the respective departments. These documents and other suggested readings are fully referenced in Appendix A.

4.1 Government of Alberta

A number of departments within the Government of Alberta have responsibilities which directly or indirectly relate to the management of water resources. The primary responsibility for water management in the province rests with Alberta Environment. The various provincial acts pertaining to water and the departments designated as responsible for their administration are summarized in Exhibit 4.1.1.

4.1.1 Alberta Environment

There are four primary functional groups within Alberta Environment (Exhibit 4.1.2):

i) Finance, Administration, Policy and Planning Services; Legislation Directly Related to Water Management;
ii) Environmental Protection Services (EPS);
iii) Water Resources Management Services (WRMS);
iv) Environmental Evaluation Services (EES).

Other groups which provide supporting investigative and research functions, often related to water are:

i) Environment Council of Alberta;
ii) Alberta Environmental Centre;
iii) Alberta Environmental Research Trust.

The Environmental Protection Services group and the Water Resource Management Services group have the bulk of responsibility for day-to-day water resource management activities.

Exhibit 4.1.1
Legislations Directly Related to Water Management

Title of Act	Administered by:
Water Resources Act	Alberta Environment
Clean Water Act	Alberta Environment
Groundwater Development Act	Alberta Environment
Agricultural Chemicals Act	Alberta Environment
Hazardous Chemicals Act	Alberta Environment
Drainage Districts Act	Alberta Environment
Land Surface Conservation and Reclamation Act	Alberta Environment
Irrigation Act	Alberta Agriculture
Soil Conservation Act	Alberta Agriculture
Public Lands Act	Alberta Forestry, Lands and Wildlife
Fisheries Act (federal) (Section 33)	Alberta Forestry, Lands and Wildlife
Wildlife Act	Alberta Forestry, Lands and Wildlife
Forests Act	Alberta Forestry, Lands and Wildlife
Public Health Act	Alberta Community and Occupational Health
Plumbing and Drainage Act	Alberta Labour
Water Resources Commission Act	Alberta Water Resources Commission

Note: A number of provincial acts are peripherally related to water management. Examples include: The Planning Act, The Hydro and Electric Energy Act, The Oil and Gas Conservation Act and the Wilderness Areas, Ecological Reserves and Natural Areas Act.

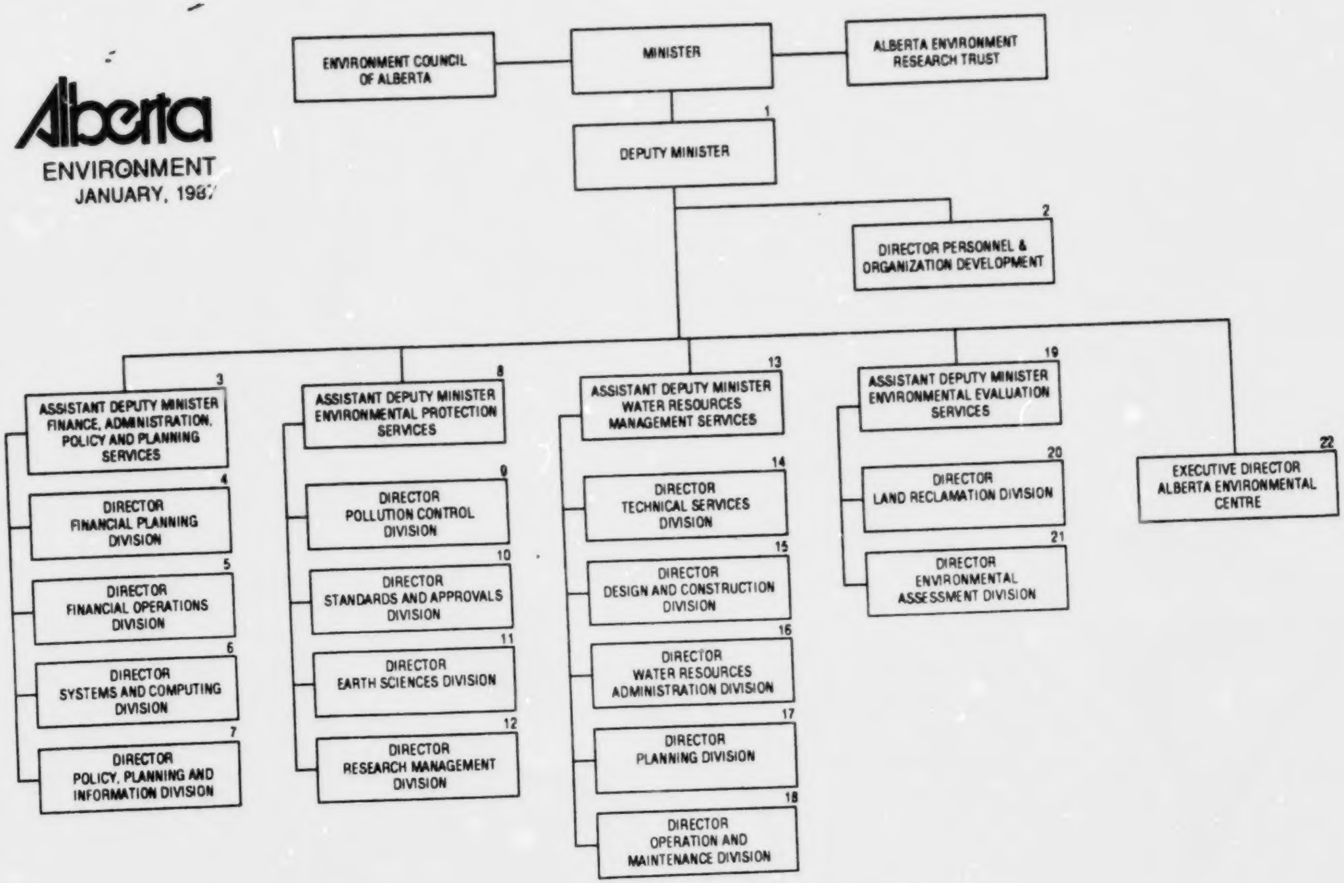

Alberta
ENVIRONMENT
JANUARY, 1987
ENVIRONMENT COUNCIL OF ALBERTA
MINISTER
ALBERTA ENVIRONMENT RESEARCH TRUST
1 DEPUTY MINISTER
2 DIRECTOR PERSONNEL & ORGANIZATION DEVELOPMENT
3 ASSISTANT DEPUTY MINISTER FINANCE, ADMINISTRATION, POLICY AND PLANNING SERVICES
4 DIRECTOR FINANCIAL PLANNING DIVISION
5 DIRECTOR FINANCIAL OPERATIONS DIVISION
6 DIRECTOR SYSTEMS AND COMPUTING DIVISION
7 DIRECTOR POLICY, PLANNING AND INFORMATION DIVISION
8 ASSISTANT DEPUTY MINISTER ENVIRONMENTAL PROTECTION SERVICES
9 DIRECTOR POLLUTION CONTROL DIVISION
10 DIRECTOR STANDARDS AND APPROVALS DIVISION
11 DIRECTOR EARTH SCIENCES DIVISION
12 DIRECTOR RESEARCH MANAGEMENT DIVISION
13 ASSISTANT DEPUTY MINISTER WATER RESOURCES MANAGEMENT SERVICES
14 DIRECTOR TECHNICAL SERVICES DIVISION
15 DIRECTOR DESIGN AND CONSTRUCTION DIVISION
16 DIRECTOR WATER RESOURCES ADMINISTRATION DIVISION
17 DIRECTOR PLANNING DIVISION
18 DIRECTOR OPERATION AND MAINTENANCE DIVISION
19 ASSISTANT DEPUTY MINISTER ENVIRONMENTAL EVALUATION SERVICES
20 DIRECTOR LAND RECLAMATION DIVISION
21 DIRECTOR ENVIRONMENTAL ASSESSMENT DIVISION
22 EXECUTIVE DIRECTOR ALBERTA ENVIRONMENTAL CENTRE

Exhibit 4.1.2
Alberta Environment — Functional Organization

Finance, Administration, Policy and Planning Services

Within the Finance and Administration Services section, the Public Communications Division provides services in media relations, communications, and environmental education in an effort to promote environmental awareness and conservation. These services include: administering the magazine "Environment Views"; developing environmental education programs; producing films, brochures, displays, reports, newsletters; organizing workshops, clinics, fairs; distributing news releases; organizing media events; and responding to public inquiries. A substantial proportion of the Division's activity is oriented towards water.

Environmental Protection Services

The Environmental Protection Services group has four divisions: the Pollution Control Division; Standards and Approvals Division; Earth Sciences Division; and the Research Management Division.

The Pollution Control Division is responsible for monitoring activities and enforcing the Clean Water Act and its regulations to ensure publicly acceptable levels of surface water and groundwater quality.

The services provided by the Water Quality Control Branch of the Pollution Control Division include: monitoring and assessment of ambient water quality, monitoring and assessment of industrial waste-water quality, review of industrial compliance reports, inspections of industrial plants and industrial waste-water treatment facilities to ensure compliance with license requirements; and in general, the enforcement of industrial regulations as outlined in the Clean Water Act.

The Municipal Engineering Branch of the Pollution Control Division has a special role regarding municipal water and waste-water management, in which it ensures that municipalities have adequate quantities of good quality potable water and that municipal waste-water discharges do not adversely affect the environment. Services provided in this capacity include: the inspection of municipal water and waste treatment facilities, monitoring of municipal waste-water discharges; review of monthly license submissions, certification of water and sewage treatment operators, and investigation of complaints.

The Pollution Control Division is also responsible for pesticide management. It controls and monitors the use of pesticides by enforcing the Agricultural Chemicals Act. It does so by providing services such as: the monitoring of pesticide residues and applications; the provision of grants and technical assistance to municipalities for pest control projects; the licensing and instruction of pesticide applicators; administration of the pesticide container collection program; and permitting various pesticide and pesticide application programs.

The Standards and Approvals Division processes applications submitted by industries and municipalities for permits to construct and licenses to operate effluent treatment and waste-water disposal facilities under the Clean Water Act. The Division ensures that municipal water supply systems, sewage projects, and stormwater systems meet provincial standards for water supply and sewage. The Division updates these standards and establishes specific performance and operating conditions for municipal water and sewer systems. The Division establishes industrial waste-water effluent guidelines and incorporates specific elements of these guidelines as conditions of licenses to operate industrial plants. The Division also contributes to ongoing departmental studies related to water quality management.

The Earth Sciences Division is involved in projects such as hydrogeologic investigation, inventory and applied research in soil and groundwater protection, waste disposal and groundwater development. The Earth Sciences Division is also responsible for groundwater development. Its role is to investigate, develop, monitor and protect groundwater supplies. More specifically, the Division is responsible for: developing a provincial groundwater inventory; operating a groundwater resources information service; investigating the impact of developments on groundwater resources; working with industry to upgrade technology; mapping groundwater resources on a regional basis; operating provincial and oil sands observation well networks; preparing the base of groundwater protection maps; and administering the Groundwater Development Act.

The role of the Research Management Division is to provide scientific and technical information to the other divisions within Alberta Environment and to plan, fund, co-ordinate and carry out scientific research requirements. The Division is involved in a wide range of water resources research in areas of hydrology, water quality, contaminants and waste-water treatment technologies. The Research Management Division also plays a role in land conservation in that it undertakes land reclamation research including co-ordinating the research with other government agencies (federal and provincial) and industries.

Water Resources Management Services

The Water Resources Management Services section has five divisions: Technical Services Division; Design and Construction Division; Water Resources Administration Division; Planning Division; and Operation and Maintenance Division.

The Technical Services Division is responsible for providing expertise in river flow forecasting, river engineering, surface water hydrology and surveying. The specific services this Division provides include: combatting ice-jams; providing information and analysis on surface water supply, streamflow, flow frequency and magnitude, lake levels and stream erosion; providing flow-forecasting service for water management and informing the public of unusual occurrences; advising on the control of stream channel erosion; delineating flood plains; advising on reservoir operations for optimum water resource management; and providing engineering surveys.

The Design and Construction Division is responsible for the implementation of surface water development and control projects including multi-purpose water supply, storage and distribution; rehabilitation of irrigation works; drainage, flood and erosion control; and lake level stabilization.

The Water Resources Administration Division has primary functions in the allocation of rights to surface and groundwater resources and in the provision of regional services such as inspection of water-related problems and administration of cost-shared projects. More specifically, this Division is responsible for: allocating provincial surface and groundwater resources using permits and licenses; administering the Provincial Water Power Regulations and the Dam and Canal Safety Regulation; overseeing the administration and operation of the drainage districts; monitoring water consumption; assisting local governments on water management projects through a program of cost-sharing (Water Management and Erosion Control Program); providing technical services to landowners for farm surface water management; providing inspection services to local governments and the public with respect to water-related problems; and authorizing drainage projects or other disturbances to watercourses and water bodies.

The Planning Division is responsible for water resources planning and co-ordination. The Division provides services such as: co-ordinating multi-disciplinary studies on water resource projects; providing planning input to cost-shared regional water resources management projects; the development of an overall water resource management plan for each river basin; the provision of a framework for provincial long-range water resources planning; development of new policies and programs for water resource management; conducting and co-ordinating environmental impact, economical and sociological assessments of water resources projects; and assessing existing water management policies, programs and projects for adequacy, efficiency, effectiveness and need for updating.

The Operations and Maintenance Division concerns itself with the operation and maintenance of water resources systems including provincial and cost-shared water development and water control systems, irrigation dams, reservoirs, and main canal systems.

The Division is also responsible for emergency streamflow maintenance, for emergency water supplies, for rehabilitation of water management projects and irrigation headworks development, for development of day-use areas at water management project sites where there is a demonstrated demand for access to water-based recreation and for operation of the Water Resources Revolving Fund.

Environmental Evaluation Services

The Environmental Evaluation Services section has two divisions — the Land Reclamation Division and the Environmental Assessment Division. Both of the divisions have a primary land conservation function. The Land Reclamation Division establishes land reclamation guidelines and ensures adherence through enforcement of the legislation and issuance of approvals, orders and reclamation certificates. It also undertakes specific reclamation projects.

The Environmental Assessment Division is responsible for establishing environmental impact assessment guidelines, for co-ordinating departmental and interdepartmental reviews and for ensuring that proponents of development proposals provide the opportunity for public review. The Division reviews land use development proposals for regional planning authorities and plans, reviews and approves land use within environmentally sensitive areas (designated as Restricted Development Areas). The Division comments on sub-division development applications from the perspective of susceptibility to flooding, bank and slope stability, erosion hazard, surface drainage, availability of domestic groundwater supply, and potential for water pollution.

Alberta Environmental Centre

The Alberta Environmental Centre is the Alberta government's central facility for environmental research, technology development and analytical and diagnostic programs for Alberta Environment and other Alberta government departments and agencies. The Centre plays an important role in the function of environmental research, services and technology. It provides, in co-operation with other agencies, a comprehensive program in environmental protection, rehabilitation, control and management. It assesses the effects of environmental changes on man, domestic animals and wildlife and conducts applied research to minimize or eliminate deleterious effects of environmental changes. More specifically, the Centre provides diagnostic services, chemical and microbiological analytical services and research regarding environmental problems. The Centre conducts a range of research and development projects involving the management of water and waste products.

Environment Council of Alberta

The role of the Environment Council of Alberta is to review and co-ordinate government and government agency policies, programs and administrative procedures and to encourage public involvement in the discussion and analysis of environmental issues. With respect to the function of environmental conservation, the Council holds public hearings and prepares reports on issues with environmental implications; it appoints public advisory committees on environmental conservation; it compiles and disseminates environmental information; it conducts a review of government policies and administrative procedures; and it holds appeals hearings on stop orders issued under provincial environmental legislation.

4.1.2 Other Provincial Government Agencies

The other provincial government agencies involved in water management in Alberta are: Alberta Agriculture; Alberta Community and Occupational Health; Alberta Forestry, Lands and Wildlife; Alberta Labour; Alberta Parks and Recreation; Alberta Research Council; Alberta Transportation and Utilities; Alberta Water Resources Commission; and the Energy Resources Conservation Board.

Alberta Agriculture

Alberta Agriculture has three divisions which are involved with water management in Alberta: the Resource Planning Division, the Irrigation and Conservation Division and the Research Division.

The Resource Planning Division supports planning activities related to the allocation, development, management and conservation of Alberta's water resources for the long-term benefit of the agriculture sector. The Division is responsible for providing irrigation project planning and land classification and resource analysis services. It provides technical support in water conservation and development to provincial and regional agencies, local authorities, and farm organizations.

The mandate of the Irrigation and Conservation Division is to ensure that Alberta's land, soil and water resources are managed and conserved in the long-term interests of the agricultural industry. It carries out this objective by promoting, to farmers, producer groups and local authorities, management and conservation techniques which encourage effective use of land and water resources for sustained agricultural production. This Division provides advisory services, technical support and financial assistance related to on-farm water and soil management through the Farmland Development and Reclamation Program (FDRP) and the Soil Conservation Area Program (SCAP).

The major objective of the Research Division is the improvement of the technological base of Alberta's agriculture industry. It is responsible for identifying and supporting the research necessary to solve problems which limit the production, processing and marketing of Alberta's agricultural products and for facilitating the transfer of technology. Through the Alberta Agricultural Research Institute and the Alberta Agricultural Research Trust, research has been supported in the areas of irrigation, drainage, and soil and water conservation.

Alberta Community and Occupational Health

The Health Services Division of Alberta Community and Occupational Health strives to enhance the quality of community life and monitor the state of public health by providing financial and other resource support for community health services. In conjunction with Local Health Units, it provides environmental health services, including the review of environmental impact assessments for industrial projects, sampling and analysis of community drinking water and monitoring of beach water quality. Local public health inspectors enforce regulations under the Public Health Act. These regulations (AR242/85) provide broad powers with respect to protection of public health including protection from water contamination.

Alberta Forestry, Lands and Wildlife

The four divisions within Alberta Forestry, Lands and Wildlife which have responsibilities related to water resource management are the Alberta Forest Service, Public Lands Division, Resource Evaluation and Planning Division, and the Fish and Wildlife Division.

Alberta public lands are divided into the Green Zone and the White Zone. The Green Zone is the non-settled forest lands. Agricultural activity and permanent settlement in this area are restricted, except on legally subdivided lands. The White Zone is the settled part of the province. Much of the land in the White Zone is privately owned and is managed for agricultural use. Public land in the White Zone is managed for watershed protection, recreation, wildlife habitat, forestry, livestock grazing and crop production.

The Alberta Forest Service has land management responsibility within the Green Zone of the province and is primarily concerned with forest resource management to ensure a perpetual supply of benefits and products while maintaining a forest environment of high quality. Services provided include: the management of public forest lands for watershed, grazing and recreational benefits; the prevention of damage to public forest lands; reclamation; the establishment, maintenance and improvement of forest stands for timber production and for recreational, grazing, watershed and wildlife benefits.

The Public Lands Division and the Resource Evaluation and Planning Division play a role in the planning and management of public lands in the White Zone. The Public Lands Division is responsible for reviewing applications and issuing dispositions for the sale or lease of public land; for conducting operational level land planning, development and management; and for providing recommendations for land use. This Division also delivers the Grazing Reserves Program and co-ordinates the Range Improvement Program on public lands.

The Resource Evaluation and Planning Division co-ordinates integrated resource planning to facilitate optimum use of Alberta's public lands with respect to watershed management, fisheries habitat and water-based recreation. It also provides professional and technical services relating to the inventory and appraisal of land surface and sub-surface resources and maintenance of an overall natural resource information system.

The role of the Fish and Wildlife Division of Alberta Forestry, Lands and Wildlife is to ensure the continued enjoyment and benefit from fish and wildlife resources through the maintenance of viable species populations and habitat. It fulfills this role by employing resource specialists who develop fish and wildlife species management plans and monitor the balance of sustained and varied use opportunities against the maintenance of sustained and viable populations. The Division plans and administers projects to enhance fish and wildlife habitat, evaluates industrial and settlement disturbances of fish and wildlife habitat and contributes to the preparation and revision of integrated resource management plan recommendations. It also liaises with private and government agencies to incorporate consideration of fish and wildlife habitat in their policies and programs.

Alberta Labour

The General Safety Services Division within Alberta Labour is responsible under the Plumbing and Drainage Act for developing safety standards and providing inspection and investigation services for private sewage disposal systems.

Alberta Parks and Recreation

The Design and Implementation Division and the Recreation Development Division are the two divisions within Alberta Parks and Recreation which have a role in water resource management. The two divisions work together to promote, encourage and co-ordinate the orderly development of recreational facilities in the province, including aquatic-based municipal and provincial parks. Other objectives are to develop and maintain a park system for the conservation and management of flora and fauna, to preserve specified areas that are of geological, cultural or ecological interest (e.g., wilderness areas and ecological reserves) and to facilitate the use and enjoyment of park areas for outdoor recreation.

The Design and Development Division provides design and development services for new and existing parks and recreation areas. The Recreation Development Division develops strategies for the parks and recreation systems development and the Ecological Reserves Program.

Alberta Research Council

The role of the Alberta Research Council, with respect to water management, is to undertake research in the fields of natural sciences, energy, engineering, biotechnology and advanced technologies. It provides research and services in subject areas that offer economic opportunities for Alberta.

Alberta Transportation and Utilities

The Department of Transportation and Utilities has within it a sector called the Utilities Development Division. The Division manages grant programs related to municipal water and sewage facilities (Municipal Water Supply and Sewage Treatment Grant Program) and to domestic and stock water transmission projects on farms (Alberta Farm Water Grant Program). It assesses applications for grant assistance using criteria such as need, cost-effectiveness, design and capacity. The Division places in order of priority eligible projects and makes recommendations for funding approval, considering factors such as need, health concerns, pollution problems and growth and community enhancement. It is also responsible for providing advisory and technical support services to municipalities and the rural sector for the development of water supply and sewage treatment facilities. Other services provided include assistance in developing terms of reference for studies, assistance in planning projects and managing consultants on behalf of communities.

Alberta Water Resources Commission

The role of the Alberta Water Resources Commission is to monitor, review and assess water resources projects, planning and policy in Alberta and advise the Cabinet accordingly. In assessing and reviewing the Alberta Government's long-term resources plans, it considers agricultural, economic, community and environmental factors.

The Commission performs evaluations of specific short-term and long-term projects which affect the water resources of Alberta and it advises the Lieutenant-Governor in Council accordingly. Indeed, the Commission advises the Lieutenant-Governor in Council respecting the exercise of any of his powers under the legislation of the Province of Alberta pertaining to water resources. It is also responsible for monitoring intergovernmental negotiations affecting the water resources of Alberta and for making recommendations in the public interest of Alberta.

Energy Resources Conservation Board

The role of the ERCB is to regulate the safe and efficient development of energy resources in Alberta, including the protection of water supplies. The Board evaluates and regulates drilling and waste-water disposal practices to protect groundwater aquifers. It also regulates experimental and commercial schemes for the recovery of heavy oil and oil sands with respect to water use, re-use and disposal. The ERCB regulates surface disturbances by energy developments and monitors water treatment technologies. The Board has field inspection offices throughout Alberta (including Grande Prairie, Bonnyville and Fort McMurray). These offices conduct a variety of technical inspections on all facets of the energy industry (including groundwater impacts, surface disturbances, salt water spills, and surface and sub-surface waste disposal), and investigate all complaints received from the public related to oil and gas production. The Board refers water-related matters to other government agencies, primarily Alberta Environment, when appropriate.

4.2 Local and Regional Authorities

Local and regional authorities in northern Alberta consist of cities, towns, villages, counties, municipal districts, regional commissions and improvement districts. Each of these entities functions at a different level of autonomy under the direction of elected representatives. Roles of the local authorities related to water include:

i) development and priorization of proposals for cost-shared water management projects; provision of the local authorities' share of funding;
ii) preparation of general municipal regional plans;
iii) enforcement of land use and other bylaws relating to water resources;
iv) development and provision of sewer and water facilities and services; levying of fees for recovery of costs;
v) establishment of and participation in Agricultural Service Boards; provision of local advice on topics such as soil and water conservation;
vi) participation in planning processes related to land and water resources (e.g., regional plans, integrated resource plans, lake management plans, water management unit plans); and
vii) participation in the provision of public health services through the local Public Health Unit.

The responsibility for taxation, provision of community services such as sewer and water, and general administration within the Improvement Districts and Metis Settlements rests with the provincial Department of Municipal Affairs. Elected Advisory Councils provide direction and guidance for the provision of local government in the Improvement Districts.

The Regional Planning Commissions play an important role in the protection of watercourses through their planning and municipal advisory processes.

The mandate of the commissions is explicitly set out in The Planning Act, 1977. Each of the commissions is required to prepare a plan for its region, assist member municipalities in preparing statutory plans or land use by-laws as requested by the municipalities, encourage participation by the general public in planning matters, and comment on proposed annexations as requested by the Minister of Municipal Affairs, the Local Authorities Board, or member municipalities. The regional planning commissions are also the sub-division approving authorities for all lands within their jurisdiction except where the minister has delegated the authority to a municipal council. They also are responsible for developing rural land use policies in conjunction with their preparation of regional plans, and for facilitating consistent sub-division decisions.

4.3 Government of Canada

The federal agencies which carry out functions related to water management in northern Alberta are Environment Canada, Agriculture Canada, Transport Canada, Health and Welfare Canada, Fisheries and Oceans Canada and Indian and Northern Affairs Canada. As noted earlier, the federal government has limited direct jurisdiction for water management within the provinces. Its mandate is limited primarily to jurisdiction in matters of national interest and a transboundary nature. The exceptions include matters related to navigation and fisheries, particularly fish habitat protection. The federal government has been particularly active in the development and co-ordination of national programs, standards and environmental guidelines. It also co-operates with the province in a number of programs (see Section 4.4). The primary federal agency with responsibility for water management is Environment Canada.

Environment Canada

Environment Canada maintains agreements with the provinces for water quality and quantity networks and for environmental protection. The two sections most involved with water management are the Inland Waters/ Lands Directorate and Environmental Protection.

The Inland Waters Directorate of Environment Canada is involved in water quantity and quality management and water resources planning. Its role is to survey national water quantity and quality and to undertake comprehensive research and planning programs in co-operation with the provincial governments to aid in the conservation, development and use of Canadian water resources. The National Water Research Institute (Burlington, Ontario) and the National Hydrology Research Institute (Saskatoon, Saskatchewan) are administered by the Directorate.

The specific services provided by the Directorate in relation to the above objectives include: collecting, processing and analysis, storing and interpreting hydrometric data on Canadian waters (Water Survey of Canada); providing water quality data and interpretive information on waters of significant national interest; recommending water quality objectives; determining the effectiveness of regulatory measures; formulating comprehensive water resource management plans for river basins for which there are some federal responsibilities; and implementing the Flood Damage Reduction Program (presently under negotiation with Alberta).

Inland Waters/Lands Directorate is also responsible (along with Fisheries and Oceans Canada and Transport Canada) for assisting in the regulation of interprovincial and international boundary water flows and levels. The Directorate is represented on water boards, is involved with the monitoring of streamflow and water quality, and participates in special investigations. It also co-ordinates the federal Interdepartmental Committee on Water.

The Lands Branch of the Directorate is involved with the Federal Policy on Land Use (FPLU), the Interdepartmental Committee on Land (ICL), and the Canada Committee on Land Use (CCLU).

The Policy Goal of the FPLU is to ensure that federal policies and programs contribute to the wise use of Canada's land resources. Land Use Guideline 5.6 is Land for Water Conservation. This Guideline states: "The impact of policies and programs on watersheds, aquifers, recharge and storage areas, and other lands critical to the quality and quantity of the nation's water supply will be considered. Appropriate action will be taken to ensure their protection."

All federal departments and agencies are required to adopt the FPLU and consider it in developing, implementing and managing their policies and programs.

Cabinet created the ICL to serve as the federal focal point for the implementation and application of the FPLU, and to be the co-ordination centre for federal/provincial/territorial discussions on land use matters. The ICL interacts with the Interdepartmental Committee on Water concerning land/water issues.

The Canada Committee on Land Use consists of senior (ADM level) representatives from provinces, territories and the federal government served by a federal Secretariat — the Lands Branch. The CCLU meets annually to provide a federal/provincial/territorial consultative committee and forum for information exchange. The committee is developing into a policy and issue oriented body, focusing on land use issues affecting all members and striving to develop common policy positions which can be applied as required in all jurisdictions. A current issue of concern to the CCLU is a national system of wetland conservation.

Environmental Protection is involved in water quality regulation and fish habitat management. Its role in the former function (a role it shares with Health and Welfare Canada and Fisheries and Oceans Canada) is to assist in the protection of the quality of Canadian waters. It does so by regulating the manufacturing, processing and importing of substances which contain water pollutants and developing guidelines for good industrial practice for use by the provinces in establishing pollution control requirements.

Its role in managing fish habitat is to conserve, restore and develop fish habitats to improve the production of Canada's fisheries resources. It administers Section 33 of Fisheries Act; however it has withdrawn from day-to-day fisheries management in Alberta.

Environment Canada is also responsible for toxic chemicals management (as is Agriculture Canada, Fisheries and Oceans Canada, Health and Welfare Canada and other departments). These federal departments work together on the Interdepartmental Committee on Toxic Chemicals (ICTC). The Committee's role is to identify major issues relating to toxic chemicals, to develop overall policy, to co-ordinate a federal approach to managing toxic chemical activities and to provide advice to Ministers on major policy and resource allocation questions.

The specific responsibilities of Environment Canada in this effort include monitoring the aquatic environment for toxic substances, conducting characteristic research on toxic substances, maintaining an inventory of potential sources of toxic substance release, assessing the potential effect of toxic substances, issuing information and warning to the public, and providing advice to the other federal departments on issues relating to toxic substances.

Environmental Canada-Parks (formerly Parks Canada) is also responsible for a program to conserve the resource values of heritage rivers. With provincial and territorial governments, they are developing a Heritage River System comprising rivers which are outstanding examples of Canada's natural heritage.

Agriculture Canada

Agriculture Canada is involved in rural water development for agricultural purposes and soil conservation planning.

The role of the Prairie Farm Rehabilitation Administration, an agency of Agriculture Canada, is to secure rehabilitation of drought and soil-drifting areas and to promote systems of farm practice, tree culture, water supply, land utilization and land settlement that will accord greater economic security for agricultural areas in Western Canada. With a view to achieving this goal, the PFRA provides technical and financial assistance to bona fide farmers and ranchers for the development of on-farm water sources and irrigation projects and to small agriculturally-based communities for the development of water supplies.

Agriculture Canada is also on the Interdepartmental Committee on Toxic Chemicals (ICTC). The responsibilities of Agriculture Canada (in relation to this committee) are the assessment of efficacy and risks of productivity and the control of pesticides through registration.

Department of Fisheries and Oceans

The Department of Fisheries and Oceans is also involved with toxic chemicals management. Its responsibilities regarding the ICTC include the monitoring of toxic substances in fish habitat, conducting characteristic research on the effects of toxic substances on fish, assessing fish edibility and productivity, controlling industrial waste disposal and advising the other federal departments on certain toxic chemical management issues.

Fisheries and Oceans also has responsibilities regarding the regulation of water quality and water quantity. It shares this role of assisting in the regulation of interprovincial and international boundary water flows and levels and in the protection of the quality of Canadian waters with other federal departments specifically Environment Canada, Agriculture Canada, Transport Canada, Health and Welfare Canada. (For examples of services provided regarding water quality regulation, see the section on Environment Canada — Environmental Protection Service.)

The Department of Fisheries and Oceans also shares the responsibility of fish habitat management with the Environmental Protection Service of Environment Canada. Again, its role is to conserve, restore and develop fish habitats in an effort to improve the production of Canada's fisheries resources. Within Alberta, this role has been delegated to Alberta Forestry, Lands and Wildlife.

Transport Canada

Transport Canada has responsibilities relating to water quantity regulations (i.e., through the Navigable Waters Act) and toxic chemicals transportation safety.

Transport Canada shares the roles and responsibilities of regulating water quantity with Environment Canada, Agriculture Canada and Fisheries and Oceans. (For examples of specific services see the section on Environment Canada — Inlands Water Directorate.)

The specific responsibilities of Transport Canada in relation to toxic chemicals management and the Interdepartmental Committee on Toxic Chemicals is to control toxic chemicals through regulations under the Transport of Dangerous Goods Act.

Health and Welfare Canada

Health and Welfare Canada plays a role in the regulation of water quality and in toxic chemical management.

Health and Welfare Canada shares the responsibilities of assisting in the protection of the quality of Canadian waters with Environment Canada and Fisheries and Oceans Canada. (For examples of specific services see the section on Environment Canada — Environmental Protection Service.)

The department's specific responsibilities on the Interdepartmental Committee on Toxic Chemicals include conducting characteristics research on toxicity to humans, assessing potential impacts on humans, controlling toxic chemicals through drinking water quality guidelines and advising other federal departments on toxic chemical related issues.

4.4 Federal-Provincial Activities

General Activities

Exhibit 4.1.3 summarizes a number of specific water-related programs in which the provincial and federal governments co-operate. Alberta has chosen not to participate fully in the national Water Quality Monitoring Program due to cost considerations and sample analysis reliability. It is our understanding that Alberta is currently engaged in discussions on full participation in the Flood Damage Reduction Program. In addition to joint program activities, the Alberta and federal governments participate in a number of boards and committees.

Prairie Provinces Water Board

The Prairie Provinces Water Board (PPWB) administers the Master Agreement on Apportionment (1969) as executed by the federal government and the provinces of Manitoba, Saskatchewan and Alberta for the apportionment of waters flowing from one province to another. The agreement stipulates that one-half of natural water flows arising in or flowing through an upstream province be allowed to pass to a downstream province. Within the scope of this study, the Beaver River is the only river relevant to the PPWB.

The Board is responsible for reviewing, collating and analyzing streamflow data and preparing reports and recommendations on the apportionment of water. It also reviews water quality problems located at the interprovincial boundaries and recommends appropriate management approaches for their resolution including the establishment of new institutional arrangements. The Board also is involved in the development of recommendations on other water matters, in addition to problems on water quality, referred to the Board. It promotes the integrated development of water resources of interprovincial streams through consultation and the exchange of information. The Board prepares factual reports on disputes regarding water apportionment. It also co-ordinates technical programs such as water quantity and quality monitoring and streamflow forecasting required for the effective apportionment of water.

Mackenzie River Basin Committee

The Mackenzie River Basin Committee was established in 1977 by a Memorandum of Understanding between Canada, British Columbia, Alberta and Saskatchewan. Representation on the Committee consists of members from Canada, the participating provinces and the Yukon and Northwest Territories.

The Mackenzie River Basin Committee is charged with the responsibility of exchanging information and providing input on studies and investigations pertaining to water, related resources, and intended developments in the Mackenzie River Basin. Services which the Committee provides include: assisting in determining the desirability of studies and investigations, undertaking any studies that are approved, and recommendations on planning for the implementation of the recommendations contained in the 1981 Mackenzie River Basin Study Report.

Exhibit 4.1.3
General Intergovernmental Programs

Title	Alberta Participation
• Water Quantity Survey Agreement	Yes
• Water Quality Monitoring Program	No
• National Inventory of Municipal Waterworks and Waste-water Systems	Yes
• Water Quality Guidelines	Yes
• Flood Damage Reduction Program	No*
• Disaster Financial Assistance Arrangements Program	Yes
• Canadian Heritage Rivers Program	No
• Accords for the Protection and Enhancement of Environmental Quality	Yes

* Under negotiation.

Canada/Alberta Northern Development Agreement

The purpose of this agreement is to increase the diversity and extent of economic, business and industrial activity in northern Alberta; to prepare and assist northern residents to access business and industrial employment opportunities; and to support the development of community and regional infrastructure in order to encourage balanced growth and continued diversification of the northern economy.

The Agreement attempts to achieve these goals by supporting new projects in northern Alberta that diversify the northern economy through the development of local resources, the capture of local spin-off from industrial development or the provision of locally required services. The agreement also supports projects which provided increased access to long-term employment opportunities for unemployed or underemployed northern residents, which increase equity and workforce participation by northerners and which address economic development issues particularly in the less-developed parts of the northern region. Projects which contribute to the community and regional infrastructure in the less-developed areas, thereby improving the economic climate, are also supported.

Thus economic development projects related to water resources and community sewer and water projects may be eligible under the program.

5.0 Water Resource Issues

5.1 Groundwater Management

5.1.1 Summary of the Issue

Groundwater is an essential resource for many communities, industries and rural residents in northern Alberta. Although the quality and availability of groundwater varies considerably across the north, there are areas where groundwater is the water supply of choice, either because of its unique local availability or because of the inaccessibility or unreliability of surface water sources.

Groundwater resources are utilized in northern Alberta for a number of purposes including household and stockwater uses in rural areas, provision of municipal supplies to communities and by the oil industry for waterflood oil recovery or steam-driven in situ oil recovery. Three primary underlying factors have led to increasing levels of concern about the protection and assurance of groundwater quality and quantity.

First, increasing demands for groundwater have led to an increasing recognition of its limited supply, particularly where quality is high. Second, advances in the technical understanding of surface water/groundwater interactions have led to increased levels of concern regarding the ultimate impacts of extensive ground and surface water withdrawals. And third, there is emerging evidence on a world-wide basis of the vulnerability of groundwaters to contamination and quality degradation resulting from a wide range of human activities.

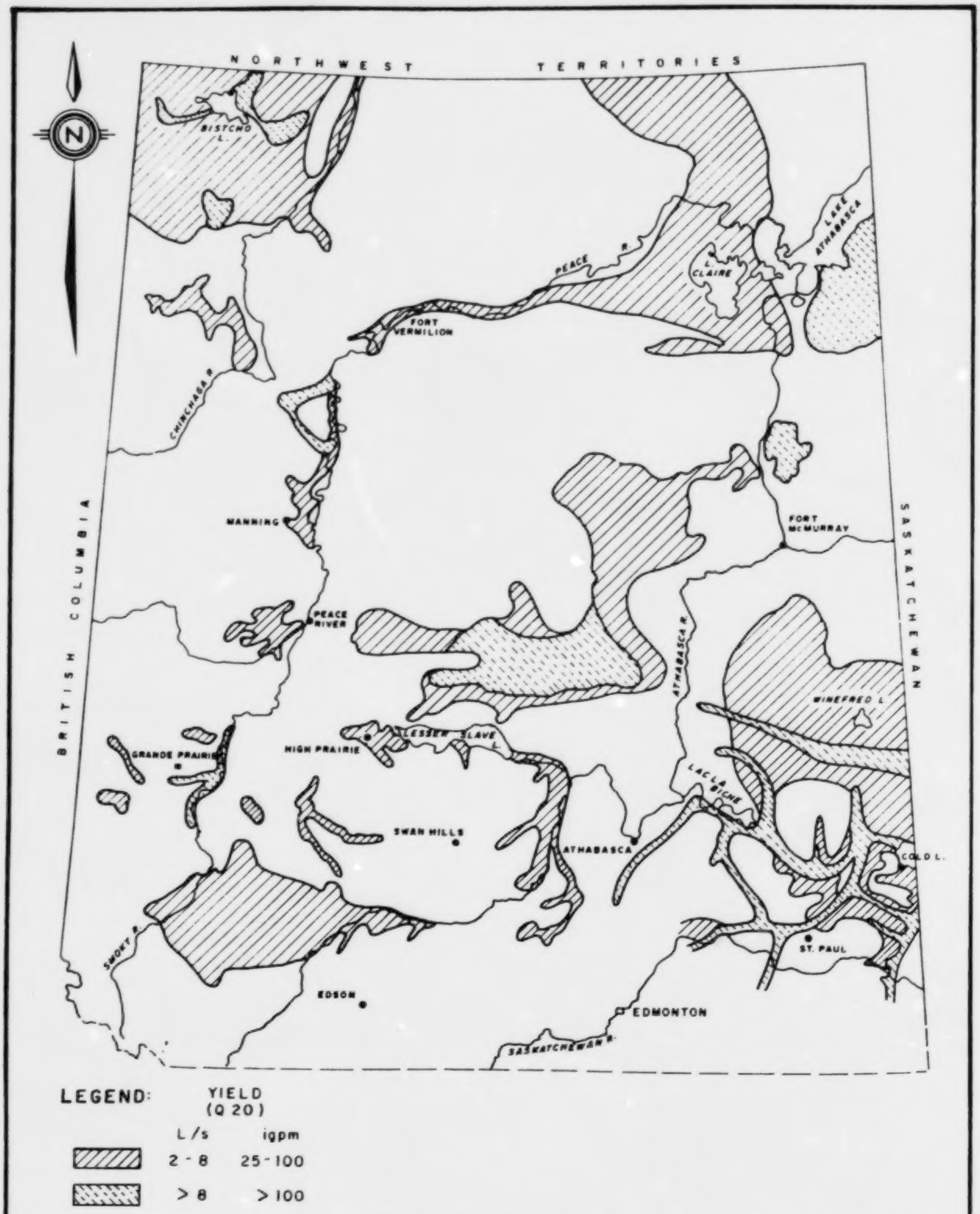
The hidden nature of groundwater resources results in a sense of mystery, apprehension and, often, a lack of trust when dealing with groundwater issues. This hidden nature also makes it technically difficult and costly to acquire the information necessary to effectively address groundwater issues.

The issues regarding groundwater in northern Alberta therefore relate to the above-noted trends and to the following unique regional circumstances in northern Alberta.

Over much of northern Alberta the groundwater resource provides relatively low yields and is often of poor quality. Quality problems relate to naturally high concentrations of iron, hydrogen sulphide gas, and dissolved solids (sodium, calcium, magnesium). Exhibit 5.1.1 provides a rough indication of those areas in northern Alberta which produce moderate to high groundwater yields. While only an approximation, this map highlights the fact that much of the populated areas of the north, particularly the agricultural areas of the Peace River Basin, do not have access to groundwater in volumes suitable for municipal or industrial use. Notable exceptions include aquifers in the Hythe/Sexsmith and Berwyn/Grimshaw areas of the Peace River Basin, the area north and west of Cold Lake, and a high yield zone near Fort MacKay in the Athabasca River Basin. Detailed studies in the Beaver River Basin indicate that there are two major bedrock channel aquifers that are of sufficient size to support major withdrawals. Other moderate and high yield areas are in the remote and sparsely populated areas of the north.

While recognizing these natural constraints on supply, there is concern among those communities using groundwater that the quality and availability of the resource be protected. Concerns regarding quality assurance have been expressed by communities of the Upper Peace Basin (e.g., Sexsmith, Hythe, Berwyn, Grimshaw) and relate primarily to the potential impacts of deforestation in the higher elevation recharge areas and to the increasing demands of the petroleum industry for use of groundwater in secondary water-flood recovery projects. The questions being asked are: Will industrial withdrawals have an effect on municipal water supplies? How will agricultural land clearing, drainage and forestry operations affect groundwater supplies?

In the Cold Lake/Beaver River area there are similar increases in petroleum industry demand for both surface and groundwater resources, in this case to be used in the generation of steam for in situ oil recovery from oil sands. The questions asked in this area are: How much groundwater is available? What impacts do groundwater withdrawals have on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NORTHWEST TERRITORIES
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FORT McMURRAY
BRITISH COLUMBIA
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HIGH PRAIRIE
GRANDE PRAIRIE
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SWAN HILLS
ATHABASCA
COLD L.
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GROUNDWATER YIELDS IN ALBERTA
EXHIBIT 5.1.1

surface water levels (and vice versa)? What factors have contributed to low water levels in lakes in the region? Achieving credible scientifically-based answers to these questions requires long-term research, but such research does not fulfill the short-term need for decisions. At present there is a limit set on maximum withdrawals of groundwater in specific areas of the Cold Lake-Beaver River Basin. Unfolding research does however have the effect of altering the rationale (either up or down) for established limits. Repeated revision of such limits has the further effect of undermining public confidence in the resource description and allocation process, no matter how soundly based.

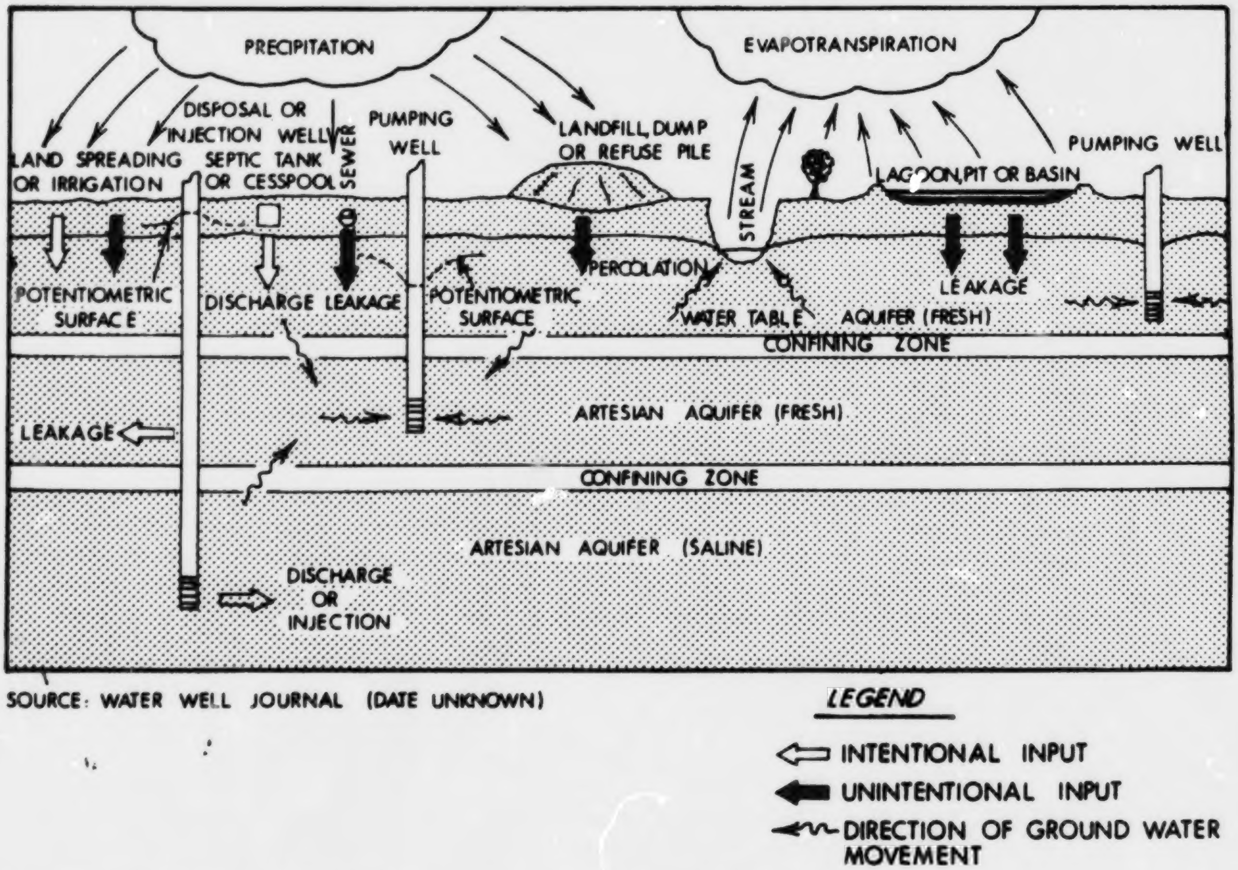
A common concern expressed as input to the project related to the protection of groundwater from contamination by:

i) oil field produced water (brine) injection;
ii) deep-well waste disposal;
iii) landfill seepage;
iv) domestic septic systems; and
v) agricultural runoff.

Exhibit 5.1.2 summarizes in graphic form the number of ways in which groundwater is vulnerable to contamination. In Alberta subsurface disposal of industrial waste fluids takes two primary forms:

i) injection of produced water from oil recovery; and
ii) disposal of industrial wastes by deep-well injection.

In addition, as noted, both surface and groundwaters are being injected into oil producing zones, either to sustain reservoir pressures or to act as a driving fluid for miscible recovery schemes.


PRECIPITATION
EVAPOTRANSPIRATION
DISPOSAL OR INJECTION WELL
SEWER
PUMPING WELL
LANDFILL, DUMP OR REFUSE PILE
PUMPING WELL
LAND SPREADING OR IRRIGATION
SEPTIC TANK OR CESSPOOL
STREAM
LAGOON, PIT OR BASIN
PERCOLATION
POTENTIOMETRIC SURFACE
DISCHARGE
LEAKAGE
POTENTIOMETRIC SURFACE
WATER TABLE
AQUIFER (FRESH)
LEAKAGE
CONFINING ZONE
LEAKAGE
ARTESIAN AQUIFER (FRESH)
CONFINING ZONE
ARTESIAN AQUIFER (SALINE)
DISCHARGE OR INJECTION
LEGEND
INTENTIONAL INPUT
UNINTENTIONAL INPUT
DIRECTION OF GROUND WATER MOVEMENT

SOURCE: WATER WELL JOURNAL (DATE UNKNOWN)

POTENTIAL PATHWAYS OF GROUNDWATER CONTAMINATION
EXHIBIT 5.1.2

All sub-surface disposal wells are regulated by the Energy Resources Conservation Board to ensure that wastes are isolated from potable aquifers and that proper precautions are taken with respect to well integrity. All deep-well waste disposal sites must be authorized and licensed by the ERCB.

Conventional oil deposits are scattered over a large part of the west half of the NADC area, with concentrations in the Swan Hills, Fox Creek, Utikuma Lake and Rainbow Lake areas. In many deposits it is not uncommon for large amounts of water, typically a brine solution, to be produced in conjunction with oil. The disposal of this brine is a problem which is typically handled by injection, either back into the oil reservoir or to some other receiving strata. Concerns have been expressed about the potential impact of produced water injection on potable groundwater aquifers.

Concerns were also expressed regarding landfill seepage, septic system releases to groundwaters and infiltration of groundwaters by agricultural chemicals (either from the areas of applications or from containers at disposal locations). Although considerable progress has been made in Alberta in developing stricter landfill siting criteria, in landfill design and in monitoring of sites, the public perception is that considerable environmental risk remains, particularly from old and abandoned rural landfills. The problems of groundwater contamination from non-point sources (e.g., agricultural chemicals, industrial herbicides, contaminated precipitation) are much more difficult to identify and correct.

The problem of seepage from septic systems into groundwater was highlighted by project participants as an example of a situation where the appropriate regulations (e.g., design, setback, capacity) may be in place but where there is considerable latitude for problems to arise and persist in the absence of ongoing monitoring and enforcement. The locating of septic tanks close to domestic water sources was raised as a particular concern.

In essence, the issue of groundwater management stems from the increasing public awareness and knowledge of the nature of the groundwater resource and problems associated with its use. The issue also stems from the need for information to be exchanged between the public, industry, regulators and researchers so that there is public confidence that the groundwater resource is being protected. The technical difficulty and required time and cost of acquiring the necessary information impedes the development of public confidence.

In the absence of clear scientific evidence of the effects on groundwater of a wide range of human activities, it was suggested by focus group and workshop participants that a conservative approach to groundwater management be taken based on research and careful monitoring of effects.

It is clear that effective groundwater management implies integrated management of land uses, surface water uses, and the full spectrum of activities that impinge on the resource.

5.1.2 Background Information

As with surface waters, the ownership of groundwater resources resides with the Province of Alberta. Management and development of groundwater is carried out under three provincial acts: the Water Resources Act, the Groundwater Development Act, and the Clean Water Act, all of which are administered by Alberta Environment. The Water Resources Act was amended in 1962 to include groundwater. The Act establishes procedures under which groundwater resources are licensed and allocated for use. Anyone wishing to divert groundwater for non-domestic purposes must obtain a license or temporary permit from the Water Rights Branch of Alberta Environment. Domestic uses typically include household or farm use, excluding irrigation and feedlot supply. Non-domestic uses include municipal and industrial uses as well as for institutions, commercial establishments and feedlots. Temporary permits are most often issued for construction camps, pilot plants and dewatering wells for construction sites and mines. The current licensing process for permanent uses requires application for an exploration permit and pumping tests prior to a subsequent documented license application. Public advertising of the application may be required. Public concerns are addressed and other affected agencies and groups are contacted prior to a decision on issuance of a license. Current policy is that "it is the responsibility of the applicant to demonstrate that sufficient groundwater is available for the project and that diversion of the required amount of groundwater will not have an unreasonable effect on wells in the surrounding area" (Alberta Environment Groundwater License Application Guidelines).

The Groundwater Development Act ensures that proper methods are used in developing groundwater resources. Under the Act, wells must be drilled by licensed, qualified drillers and drilling reports submitted to Alberta Environment.

The Clean Water Act regulates groundwater quality by controlling the disposal of contaminants in surface waters or groundwater. In addition, protection of groundwater/wells from surface contamination is generally achieved through the siting and development requirements/regulations of the Groundwater Development Act. These requirements ensure wells are properly developed, sealed and sited to prevent surface runoff from entering them. Protection from the movement of contaminated injection water into producing groundwater aquifers is achieved through the Energy Resources Conservation Board operating regulations pursuant to the Energy Resources Conservation Act. These regulations ensure the oil production formation is insulated from groundwater producing zones.

The Hydrogeology and Groundwater Protection Branches of the Earth Sciences Division of Alberta Environment are responsible for all technical investigations and scientific facts related to the development and protection of groundwater including water well production or problems, contamination, or any other outside effects on groundwater aquifers. The group is presently examining the need for a "Groundwater Protection Act."

Alberta Environment maintains a broad information base on groundwater which includes the following elements:

i) driller reports providing detailed production test and log data;

ii) consultant reports submitted on resource development projects, sub-division applications and applications for groundwater diversion;

iii) test hole data from oil and gas exploratory drilling and coal exploration as well as information on flowing shot holes drilled by seismic companies;

iv) water quality data resulting from water analyses conducted in conjunction with local Health Units (over 10,000 analyses per year); and

v) basic data gathering by Alberta Environment including:
   - a provincial network of approximately 200 monitoring wells to establish backgroundwater levels and chemistry; additional monitoring wells in the oil sands area;
   - special local monitoring wells to monitor significant water storage and diversion activities (e.g., Cold Lake Region — approximately 20 to 40 wells); and
   - high quality chemistry analysis of selected wells on an annual basis; specialized trace analysis of 30 to 35 wells per year.

   Well information is compiled and made available to the public and industry upon request. Detailed information is retained on computer files, microfilm and bibliographic data bases.

vi) maps: surficial and bedrock geology, bedrock topography, hydrogeology, base of groundwater protection. The latter map indicates an approximate base to which groundwater should be protected and a depth for setting and cementing oil well casing. Much of northern Alberta has either not yet been mapped or is mapped at a reconnaissance level of detail (e.g., bedrock topography, hydrogeology).

vii) specific studies: the Earth Sciences Division of Alberta Environment compiles a record of groundwater contamination problems which have been identified through industrial and governmental monitoring programs.

Disposal wells less than 600 metres deep are referred by ERCB to Environment for review and approval. Alberta Environment is considering direct involvement by government in the construction and monitoring of observation wells and other detection methods in the Cold Lake area.

Alberta Environment (Groundwater Protection Branch) conducts investigations to assess the hydrogeological suitability of proposed municipal landfill and pesticide container sites; the Department also actively monitors "priority 1" landfill sites (i.e., those posing a potential public health threat); no "priority 1" sites are located in northern Alberta.

viii) community groundwater supply data: provides a compendium of information for approximately 400 communities in Alberta which use, or have used, groundwater; basic information on location, yield, usage, quality is provided.

In addition to Alberta Environment, a

number of other provincial agencies have an involvement with groundwater management.

The Alberta Research Council, Groundwater Division, was established primarily to evaluate the groundwater resources of the province through the collection and analysis of groundwater data. It was the provincial repository for groundwater information and had a primary responsibility for groundwater resource mapping. The Terrain Sciences Department, Alberta Research Council, now acts primarily as a co-operating agency in joint groundwater research and inventory projects.

The Alberta Energy Resources Conservation Board regulates aspects of the petroleum industry in Alberta. The Board currently licenses water wells deeper than 500 feet to ensure control of gas leaks and enforces regulations to prevent contamination or depletion of groundwater during oil and gas drilling.

Alberta Agriculture assists in the development of farm water supplies. Once a well has been drilled, the department provides technical advice in the selection of pumps and water treatment facilities, and offers interpretative water analysis for livestock purposes.

Alberta Forestry, Lands and Wildlife is responsible for the conservation of groundwater resources from interferences by mineral exploration and development (e.g., seismic activity). Alberta Municipal Affairs is involved in financial assistance programs to municipalities for water supply; each of the IDs or MDs set their own standards in terms of water well pumping capacities. Alberta Transportation and Utilities often utilize groundwater from wells to supply the Group Regional Distribution Systems which they are presently supporting.

In response to concerns regarding the use of potable groundwater for waterflood enhanced oil recovery, Alberta Environment has initiated a review of its policy on this use, working in conjunction with a wide range of organizations, including the Alberta Association of Municipal Districts and Counties (AAMD&C), the Alberta Water Well Drilling Association, and petroleum industry associations. A draft policy has been developed which is intended to manage the groundwater resources of the Province of Alberta in such a manner "as to provide continuing protection to the existing and future domestic, municipal and agricultural water users in the rural community while maintaining the important historical and legislative principle of multi-purpose use of water". Key elements of the draft policy are as follows:

i) use of potable groundwater for oil field injection purposes will be restricted to a maximum of one-half of the long-term yield of a given aquifer in the immediate vicinity of the water source well;

ii) applicants are required to undertake an appropriate level of investigation into the use of surface water, non-potable groundwater and non-water alternatives to potable groundwater;

iii) annual extensions of approvals for oil field injection will be granted if drawdown limitations are not exceeded, there are no unreasonable negative impacts on community needs and no applications have been received from the rural community which exceed remaining available aquifer supply;

iv) the applicant must monitor the production well, observation wells and, where required, local domestic or agricultural production wells; monitoring data must be made available to the public.

In a news release dated 3 July 1987, Alberta Environment announced the establishment of the Cold Lake-Beaver River Groundwater Allocation Task Force that will develop recommendations on groundwater allocations in the Cold Lake-Beaver River Basins. A nine member team consisting of three public, three industry and three government representatives has been asked to submit recommendations on how groundwater should be allocated, including limits on use and monitoring requirements. In its first meeting the task force identified five key items to be addressed:

i) The technical understanding that exists about ground and surface water availability and the interaction between ground and surface water.

ii) The status, communication to the public and enforcement of the existing and proposed policies on groundwater and surface water allocations and water quality.

iii) The extent and cause of low surface water and groundwater levels observed in some areas of the region and any potential impact caused by existing withdrawals, precipitation and land use changes.

iv) Groundwater monitoring needs, particularly for further assessing the groundwater-surface water interaction.

v) Methods to clarify or improve the procedures used to resolve groundwater well complaints.

5.1.3 Key Concerns and Suggested Actions

The key areas of concern, as identified by contributors to the pre-conference activities, have been grouped as follows:

- Groundwater Contamination
- Surface Disturbance Impacts
- Industrial Withdrawals
- Resource Inventory
- Abandoned Wells and Drill Holes
- Public Information and Problem Referrals.

These areas of concern highlight the importance placed by the public in the protection of groundwater resources, either from the point of view of supply assurance or quality. Overall points made by the public were that there must be a "willingness to act," that the "importance of water must be acknowledged" and that "public information and education is essential."

Groundwater Contamination

Concern with contamination of groundwater is particularly strong since the effects may often go undetected for some time before remedial action is taken. Public information is essential in order to establish an appreciation of the mechanics of groundwater flow and the risks associated with such activities as produced water disposal, deep-well waste injection and landfilling. In the absence of generally available monitoring information the public is unable to properly assess these risks.

The following actions were suggested by conference delegates:

Landfill Sites

- New and old landfills should be continuously monitored to ensure that any contamination of groundwater is identified and investigated.
- New landfill sites should be subject to an approval system and monitored on a continuous basis by the department of public health.
- Old landfill sites should be cleaned up and made safe.

Chemical Containers

- Greater public compliance in disposing of chemical containers (particularly agricultural chemical containers) should be encouraged through public information campaigns, greater controls on unrestricted access to landfills, and a container incentive program.
- Containers should be regularly collected and safely disposed of in the appropriate locations (e.g., Swan Hills disposal site).

Well Contamination

- Public awareness of water quality testing should be raised to encourage regular voluntary testing of domestic wells for contamination.
- Government should ensure that there are sufficient laboratory facilities, possibly on a regional basis, available to analyze samples.

Septic Systems

- Research should be conducted to identify functional technical answers to problems with septic systems in northern climates and soils. This information should be made available to the public.

Regulations

- Groundwater regulations and license conditions should be subject to ongoing monitoring (quality and quantity) and enforcement. License conditions should be standardized for municipalities, industry and agriculture.

Surface Disturbance Impacts

The effects of land clearing and drainage on surface hydrology are not well understood particularly in relation to specific locales in northern Alberta. The effects of these activities are even more poorly understood when considering groundwater. Suggested actions include:

Impacts of Surface Disturbance

- Realistic appraisal of land capability and potential uses, including groundwater protection, should be made before authorizing land uses or releases of public land.
- The full impacts of surface disturbances should be recognized in all major developments of land.

Research

- Further research is required into the effects of drainage and forest clearing on groundwater recharge in specific areas of northern Alberta.
- Co-ordination and co-operation among provincial departments and levels of government should be encouraged with respect to hydrogeological research studies and allocations of land and water resources.
- Information should be available to the general public in a format which is comprehensible to the general public.

Industrial Withdrawals

There is an ongoing concern that industrial withdrawals of groundwater (and surface water) have contributed to reduced lake levels in the Cold Lake-Beaver River Basin. Recent research appears to confirm a close relationship between surface and groundwater in that area (Simco Groundwater Research Ltd., 1986). Concerns in the Upper Peace River Basin are focused on the use of potable groundwater for oilfield stimulation. In each area there are current activities (see Background Information) aimed at establishing new policies and procedures.

Suggestions put forward by the delegates include:

Research

- Greater emphasis should be placed on acquiring a better understanding of groundwater/surface water interactions. Acquisition of appropriate technical data through monitoring programs and refinement of existing models are suggested.

Withdrawals

- The impacts of all withdrawals should be thoroughly assessed prior to issuance of a license.
- Adequate resource planning should take place with due consideration of cumulative impacts.

Resource Inventory

With the exception of certain communities and areas of intensive industry there has been very little detailed investigation of groundwater in northern Alberta. Although it is recognized that demand for supply typically initiates groundwater investigations, there was a feeling among contributors to the project that better baseline information was needed to identify, monitor and analyze complex problems, such as aquifer recharge and drainage effects, as well as to locate useful groundwater sources. Suggested actions include the following:

Inventory

- Emphasis should be given to the identification of long-term potable groundwater supplies and reserves for northern communities.

Drill Holes

- All groundwater drill holes should be registered and the regulations enforced, including domestic wells.

Co-ordination

- Government, industry and universities should co-ordinate and focus research on groundwater to maximize the effectiveness of research expenditures; additional research funds should be made available if deemed necessary to investigate priority problems.
- Research should be made available to the general public in layman's language.

Abandoned Wells and Drill holes

It is believed that a large number of wells and drill holes remain abandoned without proper sealing. Domestic wells drilled prior to 1978 are not currently registered. All wells and drill holes present an ongoing risk of groundwater contamination. Actions suggested to correct this problem are as follows:

Public Awareness

- All wells that may be subject to contamination should be checked and sealed as necessary and the public should be made aware of the impacts of contamination and their responsibilities in regard to abandoned wells.
- Abandoned unregistered (e.g., pre-1978) wells should be identified and sealed.

Regulations

- Existing regulations on well abandonment need to be more rigorously enforced and extended to all users including domestic users.

Public Information and Problem Referrals

Many project participants indicated a desire and need to have technical information on groundwater provided to them in less technical terms. This was particularly true of elected representatives of small communities who do not have the benefit of engineering assistance but must respond to queries from the public. Education of public representatives on basic technical matters related to groundwater (i.e., sources, flows, depletion, quality determinants and measures of quality) would assist in facilitating information dissemination. Clearer lines of authority and responsibility are required for receipt of public complaints on groundwater impacts (it is understood that industry guidelines are under development).

The following actions were suggested:

Layman's Language

- Existing and ongoing data and information on groundwater quality should be made available in a language and format which is understandable to laypersons.
- Policies and procedures related to groundwater should be communicated to the public in layman's terminology.
- There should be a co-ordinated exchange of information among the responsible agencies, industry and the general public.

Groundwater/Surface Water Relationship

- Alberta Environment and industry should work together to educate the public on technical matters related to groundwater/ surface water interactions.

Regulation and Complaints

- With respect to public complaints regarding impacts of industrial activities on domestic wells, advertising is required to create a better public awareness of the complaint registration, investigation and redress process.
- A central source of information and point of contact for complaint reports is suggested.

5.2 Community Water Supply

5.2.1 Summary of the Issue

The provision of reliable potable water supplies is essential for the social and economic well-being of northern communities. To a large degree water resources and water routes guided the locations of settlement of both original peoples and migrants to northern Alberta. The attraction of water to support basic human needs, to support renewable resource harvesting, to enable transport of goods and to serve industrial needs and recreational uses has led to the location of many population centres on or near lakes or watercourses. The assurance of high quality water supplies to fulfill community needs is a high priority for northerners. This point is evidenced by the fact that nearly 40% of water-related briefs which were received by NADC over the last 10 years have focused on municipal sewer and water problems.

The concerns of northerners regarding community water supply relate to the protection of water quality and the perceived relationship between quality and health, security of supply, adequate distribution facilities and cost. Each community is faced with a set of unique circumstances based on:

i) the inherent local availability of water suitable for community use;
ii) the population size and demands of the community for water supply;
iii) the financial capability of the community to respond to demands for water services;
iv) external impingements on the quantity or quality of water available to the community.

In some instances, communities are endowed with readily available local resources requiring minimal expense to access and utilize.

Examples include the towns of Cold Lake, Lac La Biche, Slave Lake, Fort McMurray and Peace River. In other instances, through quirks of community location which were dictated by road and rail routings, communities are dependent on unreliable and low quality surface runoff reserves. In general, there are perhaps five types of water supply circumstances encountered in northern Alberta communities:

i) Communities which are dependent on unreliable and low quality surface runoff reservoirs and, for which, alternative supply systems are very costly.
ii) High-growth resource development communities which have difficulties in providing the necessary water supply infra-structure to keep up with demand.
iii) Older, more established communities that are having problems with the operation, maintenance, upgrading and replacement of aging systems.
iv) Remote and small communities with low tax bases and dispersed populations which are difficult and expensive to service with water distribution systems.
v) Communities which are dependent on groundwater supplies and which may be experiencing depletion of the resource.

In addition, regardless of the physical source of water supply, there are common overriding concerns about assurance of water quality. Many of the influences on water quality of concern to communities are discussed in Section 5.1 (Groundwater Management) and Section 5.4 (Surface Water Quality) of this report. Some of the key questions addressed by contributors on this issue are as follows:

i) What standards should be established for the reliability, safety and convenience of water supply to communities?
ii) Is it desirable to apply the same standards to all communities? At what cost?
iii) How are the special needs of communities with particularly severe supply problems being met?
iv) Is there adequate monitoring of both raw supply and treated water to ensure that human health is protected?

Successive years of low precipitation across northern Alberta between 1977 and 1980 accentuated the problems of communities dependent on surface runoff (e.g., Woking, Sexsmith). And for many communities in which availability has appeared to be assured, questions relating to quality have emerged. For example: influences of pulp mill effluents on downstream communities such as Peace River; concerns regarding siltation and sewage contamination in Slave Lake; problems with lake contamination associated with heavy recreation use in the Lakeland area; and concerns related to agricultural chemicals and industrial effluents in the Lower Athabasca Basin.

The unique conditions and problems of Indian and Metis communities in northern Alberta were also highlighted in workshop and focus group discussions (see Section 5.9).

Although substantial progress has been made in assuring potable water supplies for these communities, concerns continue in the areas of resource protection, upgrading of service standards and lack of training in the operation and maintenance of facilities.

5.2.2 Background Information

Exhibit 5.2.1 summarizes inventory information on source, distribution system and treatment of community water supplies in the NADC area, as of 1985. Of 117 communities listed, some 40 communities are on wells or springs, approximately 50 are on direct supplies from lakes and rivers, and the remainder (27) derive supplies from surface sources augmented by reservoirs. Most of the communities (81) have full or partial piped distribution, 8 have trucked distribution, and 27 have no distribution. The communities with no distribution system or using trucking are predominantly small remote communities, Metis settlements or Indian band settlements.

Two comprehensive studies on different aspects of the adequacy of community water supply in the north have been conducted in recent years. In 1985, a study conducted on behalf of Alberta Utilities and Telecommunications (Alberta Utilities and Telecommunications, 1985) surveyed 58 smaller communities across the north to determine existing service levels and the requirements for upgrading sewer and water facilities. Of the 58 communities (ranging in population from 35 to 882) it was determined that 18 had elementary water supply systems (water points with private wells or storage), 18 had intermediate systems (water points throughout community, central service to institutions, treatment and storage) and some 22 had conventional or advanced systems (full service with hydrants). The per capita capital cost of upgrading all communities to conventional service was estimated to be approximately $4,900 (1985). Thus, among smaller communities, there clearly remains a mix of supply systems with a significant proportion of unpiped systems. The constraints to providing piped central water service to such communities are the high unit capital costs associated with small populations and scattered residences.

The second study (Alberta Environment, 1983) examined surface water availability to 22 communities in the Peace River Basin. The communities varied in population from 60 persons (Hamlet of Tangent) to 2200 persons (Town of High Level). The study examined the capability of water supply systems to fulfill existing and future needs based on normal and low flow assumptions. The study concluded that in all communities, at present levels of demand, water shortages should not occur in years of normal or high runoff. At low runoffs (e.g., 50-year drought) shortages would be expected at present demands in Tangent, Spirit River and Woking and within five years at Bluesky, Little Buffalo, Peoria and Wanham. These studies together indicate the diverse mix of service levels, supply reliability and costs of upgrading facilities in northern Alberta. Recent drought years have illustrated the vulnerability of some communities, particularly those on surface runoff, to water supply constraints.

A number of technical and financial support programs have been in place to assist communities in securing reliable water supplies. Significant advances in the provision of potable water were made under the Northern Water Supply Program (which was preceded by the Metis Water Supply Program) over the 1973 to 1980 period. The goal of this program was to ensure the availability of safe and secure water supplies, principally through the provision of wells and treatment plants. Between 1973 and 1980, approximately $5,000,000 was spent on construction of over 600 wells, six treatment plants and other facilities in 35 northern communities. A review of the program in 1980 (Alberta Northern Development Branch, 1980) drew the following key conclusions:

i) problems with land tenure for well locations often restricted general public access and left the responsibility of operation, maintenance and repair unclear;
ii) without clear responsibility for ownership and maintenance, many wells went into disrepair and were inoperative;
iii) securing capable well drilling contractors in isolated areas was a problem;
iv) cisterns of conventional design were determined to be useless in northern conditions;

Exhibit 5.2.1
Community Water Facilities — Northern Alberta

Community	Supply and Distribution	Treatment
Anzac	Community well None	Chlorination Iron removal
Ardmore	Community wells, reservoir Piped	Filtration, chlorination Iron removal
Ashmont	Upper Mann Lake Piped	Chlorination
Athabasca	Athabasca River Piped	Complete
Atikameg	Utikuma Lake, reservoir Truck	Partial
Beaver Lake	Individual wells None	None
Beaver Lake Band	Lac La Biche Truck	Complete
Beaverlodge	Beaverlodge River Piped	Complete None
Berwyn	Community wells, reservoir Piped	None
Bezanson	Community wells Piped	None
Big Prairie	Creek, water-point None	None
Blue Ridge	Community wells Piped	Chlorination
Bluesky	Surface runoff, reservoir Piped	Filtration, chlorination
Bonnyville	Moose Lake Piped	Complete
Boyer River	Ponton River, water-point Trucked	Complete
Boyle	Skeleton Lake Piped	Filtration, chlorination
Brownvale	Individual wells, community wells Piped	Softening None
Cadotte Lake	Community wells None	None
Calais	Sturgeon Lake Piped	Complete
Calling Lake	Calling Lake Some piped, truck	Complete
Canyon Creek	Lesser Slave Lake Piped, truck	Complete (including activated carbon)
Caslan	Individual and community wells Truck	Chlorination, ion exchange
Chateh	Sousa Creek, water-point Some piped	Complete
Chipewyan Lake	Chipewyan Lake, water-point None	Filtration, chlorination
Clairmont	Community wells Piped	Chlorination None
Cold Lake	Cold Lake Piped	Complete
Cold Lake First Nations	Cold Lake Some piped	Complete
Colinton	Community wells Piped	Iron control
Conklin	Individual and community wells None	Iron control
Debolt	Community wells Piped	Chlorination
Dixonville	Community wells Piped	Chlorination
Donnelly	Winagami Lake, reservoir Piped	Coagulation, filtration, chlorination
Driftpile	From High Prairie or Faust None	None
Eaglesham	Surface runoff, reservoir Piped	Complete
East Prairie	East Prairie River, individual wells None	None
Elizabeth	Individual wells, community well None	Chlorination, softening Iron control
Elk Point	Creek, reservoir Piped	Coagulation, filtration, chlorination Fluoridation
Enilda	From High Prairie Piped	None
Fairview	Gerry Lake, wells, reservoir Piped	Filtration, chlorination Fluoridation
Falher	Winagami Lake Piped	Complete Fluoridation
Faust	Lesser Slave Lake Piped	Filtration, chlorination
Fort Assiniboine	Community well Piped	Chlorination
Fort Chipewyan	Lake Athabasca Piped	Chlorination, filtration

Community	Supply and Distribution	Treatment
Fort Kent	Community well, reservoir Piped	Filtration, chlorination Iron control
Fort Mackay	Fort McMurray Trucked	None
Fort McMurray	Athabasca River Piped	Complete
Fort McMurray Band	From Fort McMurray None	None
Fort Vermilion	Peace River Piped	Coagulation, filtration, chlorination
Fox Creek	Community wells Piped	Chlorination Iron removal
Fox Lake	Community wells Some piped	Chlorination
Frog Lake	Frog Lake, water-point Truck	Partial
Garden Creek	Peace River, Garden Creek, wells None	None
Gift Lake	Gift Lake Some Piped	Chlorination, filtration
Girouxville	Winagami Lake, reservoir Piped	Complete
Glendon	Minnie Lake Piped	Chlorination
Goodfish Lake	Individual wells, water-point None	Partial
Grand Centre	Cold Lake Piped	Filtration, chlorination Fluoridation
Grande Cache	Victor and Grande Cache Lakes Piped	Filtration, chlorination
Grande Prairie	Wapiti and Bear Rivers Piped	Complete
Grimshaw	Community wells, reservoir Piped	Chlorination Fluoridation
Grouard	Lesser Slave Lake Piped	Sedimentation, filtration, chlorination Iron control
Heart Lake	Lake, individual wells, cisterns Truck	Filtration (wells), complete (water-point)
Heinsburg	Individual wells None	None
High Level	Footner Creek Piped	Coagulation, filtration, chlorination Fluoridation
High Prairie	West Prairie River, reservoir Piped	Complete
Hines Creek	Jackfish Creek Piped	Complete
Horse Lake	Community wells Piped	Chlorination
Hythe	Individual wells, community wells Piped	None
Janvier	Christina River, reservoir Some piped, truck	Complete
Jean D'Or Prairie	Lawrence River, water-points Some piped	Chlorination
Joussard	Lesser Slave Lake Piped	Filtration, chlorination
Kehewin	Kehewin Lake, water-point Truck	Chlorination
Kikino	Lone Pine Lake Some piped, truck	Complete
Kinuso	Swan River, reservoir Piped	Complete
La Crete	Community well Piped	Softening, chlorination
La Glace	Individual well, community wells None	None
Lac La Biche	Lac La Biche Piped	Filtration, chlorination Fluoridation
Little Buffalo	Community well None	Chlorination, filtration, carbon
Loon Lake	Loon River None	Complete
Mallaig	Denning Lake, reservoir Piped	Chlorination
Manning	Notikewin River Piped	Complete Fluoridation
Marie Reine	Surface runoff, dugout None	Filtration, chlorination
McLennan	Winagami Lake Piped	Complete Fluoridation
Meander River	Community wells Some piped	Chlorination
Nampa	Heart River, reservoir Piped	Complete
North Star	Surface runoff, reservoir None	Chlorination
Paddle Prairie	Boyer River, reservoir None	Complete
Peace River	Peace River Piped	Complete Fluoridation
Peerless Lake	Peerless Lake None	Complete

Community	**Supply and Distribution**	**Internal Roads**
Plamondon	Gardner Lake, reservoir Piped	Filtration, chlorination
Rainbow Lake	Spring, reservoir Piped	Coagulation, filtration, chlorination
Red Earth Creek	Loon Lake None	None
Rochester	Individual wells None	None
Rycroft	Spirit River, reservoir Piped	Complete
Saddle Lake	Saddle Lake, reservoir Piped, truck	Partial
St. Paul	Lac St. Cyr Piped	Complete Fluoridation
Sandy Lake	Individual wells None	None
Sexsmith	Community wells Piped	Fluoridation
Slave Lake	Lesser Slave Lake Piped	Complete Fluoridation
Smith	Athabasca River Piped	Chlorination, filtration
Spirit River	Spirit River, reservoir Piped	Complete Fluoridation
Sputinow	Individual and community wells Piped, truck	Chlorination, softening Iron control
Sucker Creek	Trucked from High Prairie None	None
Swan Hills	Freeman Lake Piped	Complete Fluoridation
Tall Cree	Community well, water point None	None
Tangent	Surface run-off, reservoir Piped	Filtration, chlorination
Trout Lake	Community well None	Iron removal
Valleyview	Sturgeon Creek Piped	Complete Fluoridation
Wabasca-Desmarais	North Wabasca and South Wabasca Lakes Piped	Complete
Wanham	Surface runoff, reservoir Piped	Complete
Wembley	Community well Piped	None
Whitecourt	McLeod River Piped	Complete Fluoridation
Whitelaw	Spring, reservoir Piped	Chlorination
Woking	Saddle River, reservoir Piped	Complete
Worsley	Surface runoff, creek, reservoir Piped	Complete
Zama Lake	Community wells None	None

Note: "Complete" treatment includes coagulation, sedimentation, filtration and chlorination. Fluoridation and iron removal/control are optional additives.

Source: Northern Alberta Development Council, 1985, Inventory of Infrastructure for Northern Alberta Communities 1985

v) groundwater quality problems necessitated treatment plants in a number of locations; the technology of treatment required some experimentation and success depended on knowledgeable operation and maintenance;

vi) inexperience and lack of training in well and plant operation, and a lack of qualified people, resulted in system breakdown and abuse;

vii) vandalism and neglect of wells left a large proportion inoperative.

The experiences gained over this period led to some key program changes including an emphasis on community systems comprising centralized wells, reservoirs and treatment facilities with distribution by pipe or truck. However, inappropriate systems are still being installed (e.g., Wabasca). Responsibility for operation and maintenance has been designated to Alberta Municipal Affairs and considerable emphasis is now given to operator training and quality monitoring.

Currently, the major programs of assistance for community water and sewage are as follows:

i) Alberta Municipal Water Supply and Sewage Treatment Grant Program (AMGP);

ii) Regional Utilities Program (RUP);

iii) Northern Supplementary Fund (NSF).

The Municipal Utilities Branch of Alberta Transportation and Utilities administers these programs. Staff of this Branch provide guidance and financial and technical assistance in carrying out water and sewer projects. The Branch develops criteria for grant assistance, assesses applications, determines project priority and provides advisory services to municipalities.

Complementing this role, the Standards and Approvals Division of Alberta Environment ensures, by licensing, that water and sewage works meet appropriate standards of design and operation. The Pollution Control Division of Alberta Environment subsequently monitors municipal plants to ensure that standards of operation and water quality are being met. The division also provides training and certification for municipal water and sewage plant operators.

The Municipal Grant Program (AMGP) is designed to assist municipalities with the capital cost of installing modern and adequate facilities for water supply and sewage treatment. Water supply projects such as water storage facilities, water treatment plants, wells, supply lines and some transmission mains are eligible. Project costs are shared on a 75/25 provincial/municipal basis for the first 600 persons and on a 50/50 basis for the population from 601 to 100,000. Introduction of these cost-sharing arrangements in 1983 have, according to the Municipal Utilities Branch, encouraged more critical reviews and decision-making at the local authority level. Much of the responsibility for the planning of upgrading and expansion of water supply rests with the local authority. The Branch encourages the development of five-year master infrastructure plans which assist in planning of budget requirements.

The Regional Utilities Program (RUP) is intended to provide cost-effective and environmentally acceptable water and sewage facilities jointly to two or more municipalities. Regional utilities commissions may be formed to manage and administer the facilities. The province, in the future, will encourage municipalities to take the leadership role in implementation of regional facilities. Existing regional systems are concentrated in the major urban centres of the province, although the Cold Lake/Grand Centre area has a sewage and water system administered by a Regional Services Board.

The Northern Supplementary Fund (NSF) provides funding to municipalities within the NADC area for initiating or improving water and sewage facilities where, even with local revenues and other sources of income, the costs of projects are far in excess of the provincial norm. Program co-ordination is provided by the Northern Supplementary Committee consisting of representatives from Alberta Municipal Affairs, Northern Development Branch, and Alberta Transportation and Utilities. The fund serves as a mechanism to reduce a community's share of a project cost in conjunction with AMGP funding.

Additional assistance may be provided by the federal Prairie Farm Rehabilitation Administration through that agency's Rural Water Development Program. Technical and financial assistance under this program may be made available for water supply projects to rural communities of less than 300 population.

Alberta Municipal Affairs is distributing $500 million in budgetary savings to Alberta municipalities over the next nine years as part of the Alberta Municipal Partnership in Local Employment Program (AMPLE). Municipalities are encouraged to use this initiative to fund infrastructure replacement.

The Canada/Alberta Northern Development Agreement also has provisions for special funding of community infrastructure, including water supply, which is necessary to encourage economic development.

Exhibit 5.2.2 presents a summary of funds expended under the AMGP, RUP, and NSF programs from 1979/80 to 1986/87. Approximately one-third of total spending accrued to northern Alberta (e.g., approximately $24 million in 1986/87). At present, approximately $30 million of capital water projects in Northern Alberta exist as current and proposed projects under AMGP and an additional $16 million of projects are current or proposed under NSF (compared to NSF annual funding of $2 million). Clearly there is a backlog of intended work to be done in smaller communities under supplementary funding.

In the focus groups and workshops, concern was expressed regarding the inadequacy of community water supplies for fire protection. Alberta Transportation and Utilities reports that the provision of water facilities for fire protection depends to a large degree on local conditions, local priorities and affordability. Most municipalities are providing for some level of fire protection, depending on the capability of their entire system and affordability. The supply and distribution system needs to be compatible to provide effective fire protection. It is difficult to apply the same standards and criteria to each situation. Engineering consultants should evaluate the particular system and determine the most cost-effective and reasonable approach. The Insurers' Advisory Organization provides criteria for fire-flow for the purpose of obtaining the lowest fire insurance premium rate.

Alberta Environment's standards and guidelines indicate that the provision of fire protection is an aspect of water distribution that is solely the decision of the local authority. For details regarding fire protection requirements in municipal waterworks system design, the designer should refer to the Fire Underwriters Survey publication entitled *Water Supply for Public Fire Protection — A Guide to Recommended Practice.*

Exhibit 5.2.2

**Provincial Expenditures –
Municipal Sewer and Water Support Programs**

	PROGRAM YEAR (in millions of dollars)								
	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88*
AMGP	26.2	69.0	98.2	100.9	69.6	39.8	38.2	39.9	40.0
RUP	0.3	16.5	31.7	45.3	46.2	27.8	24.8	19.7	5.0
NSF	0.9	0.5	4.0	5.7	5.4	5.4	3.4	5.0	2.0
Totals	27.4	86.0	133.9	151.9	121.2	73.0	66.4	64.6	47.0

AMGP: Alberta Municipal Water Supply and Sewage Treatment Grant Program
RUP: Regional Utilities Program
NSF: Northern Supplementary Fund

* projected expenditures.

Disbursements of grants for water projects from program years 1979 to 1986 in northern Alberta as compared to the entire Province was approximately one-third of the total.

5.2.3 Key Concerns and Suggested Actions

Project contributors identified five key areas of concern related to community water supply:

- Assurance of Reliable Supply;
- Operation, Maintenance and Replacement of Systems;
- Long-term Planning, Co-ordination and Implementation;
- Special Circumstances of Small and Remote Communities; and
- Protection of Water Quality.

Within each area of concern specific actions were suggested by conference delegates to address the problems and needs of northern communities.

Assurance of Reliable Supply

Several communities expressed concern regarding the reliability of water supplies. The concerns related to susceptibility of surface runoff supplies to drought, to drawdown of groundwater supplies or to a lack of supply capacity in high growth communities. The following suggestions were made by delegates:

- Incremental funding is required for expansion and upgrading of water supply systems to provide assured reliable supplies; existing program should be sustained and enhanced where feasible.
- Remote and isolated communities should be given special assistance in locating and maintaining a reliable community water supply. New communities should not be built unless a sufficient long-term water supply of acceptable quality exists.
- The water licensing program should include provision for technical evaluations, correlation of data and ongoing monitoring to ensure supply; the cumulative impacts of industrial withdrawals of surface and groundwater must be identified.

(Note: Other actions related to groundwater supplies are identified in Section 5.1.3).

Operation, Maintenance and Replacement of Systems

Many of the more established communities are now experiencing problems and high costs in operating and maintaining old treatment and distribution systems. Since provincial funding covers capital costs only, delays in upgrading infrastructure result in heavy ongoing maintenance costs.

Part of this problem relates to the budgeting process whereby communities have not committed sufficient annual budgets for maintenance and replacement. With constraints on provincial funding the onus will increasingly be on the communities themselves to build replacement costs into annual budgets and user charges. The following suggestions were made:

- Training and upgrading should be provided for operators of facilities especially in small and remote communities. Educational requirements should be looked up with respect to small communities and a local hiring policy.
- A provincial and municipal program which would assist in the sponsorship of one trained operator per community would assist in assuring quality control at water treatment facilities.
- Consideration should be given to sharing operators among communities where applicable and to possible privatization of operation.
- The province and municipalities should begin to monitor the replacement needs of communities. A funding formula which meets the needs of all parties involved should be discussed and recognized.
- Water conservation should be encouraged through the user-pay principle, metering and public information dissemination.
- Consideration should be given to provincial funding of operation and maintenance costs in circumstances of unique need.

Long-term Planning, Co-ordination and Implementation

The final responsibility for community water supply planning rests with the local authority. The capabilities and awareness of local authorities for conducting long-term planning varies with the size of the community and the experience of municipal councillors, managers and engineers. Participants in the focus groups and workshops emphasized the need for local authorities to take leadership in planning and for the provincial government to provide adequate technical and financial advisory services to prompt and support long-term planning. The following actions were suggested:

- Water supply planning should be broadly based with the involvement of provincial, municipal and local input. Provincial

assistance may be required to support technical evaluations, data assembly and long-term community water supply planning.
- Municipalities should consider the cost of sharing water supply planning, e.g., by sub-basins or by communities with similar problems.
- Regional water systems and water co-operatives should be considered in the planning process as possible methods of servicing communities.

Special Circumstances of Small and Remote Communities

The ongoing unique conditions encountered in small and remote communities were highlighted by project contributors.

Experience with the Northern Water Supply Program between 1973 and 1980 demonstrated the social and administrative constraints faced in providing and maintaining functional systems. Existing programs have been significantly improved based on that experience. While recognizing the natural and engineering cost constraints in providing advanced systems to all communities, further development is required. The following suggested actions were put forward:

- A task force approach should be adopted to solve the water supply problems of small communities (e.g., financial burden, water sources, operator training, quality monitoring); the task force should include the three levels of government, local people and cross-departmental representation;
- Emphasis should be given to ongoing training and education to support local operation and maintenance of water supply systems;
- Existing programs of special support (Northern Supplementary Fund, Northern Development Agreement) should be sustained.

Protection of Water Quality

As industrial, agricultural, recreational and commercial activity increases in the north, there will be further pressures put on the quality of water resources, including those used by communities for local supply. Participants stressed that vigilance and enforcement must be maintained in order to ensure that potable resources suitable for existing or potential community needs are not jeopardized. These suggested actions were put forward by conference delegates:

- Government should give a higher priority to monitoring and enforcement of water quality standards.
- The provincial government should give more assistance to municipalities in trouble-shooting and problem solving with respect to water quality.
- Techniques of monitoring and data management need to be improved to support an effective enforcement process.
- Environmental impact and assessment procedures need to be strengthened with more public input incorporated in the approval process; particularly with respect to downstream water users.
- Cumulative effects must be considered when assessing water quality impacts of upstream effluents or waste disposal wells. Non-point pollutants should be considered in planning for and protecting water supplies and quality.

Additional actions relevant to this area of concern are described in Section 5.4 on Surface Water Quality and Section 5.1 on Groundwater Management.

5.3 Farmland Drainage and Erosion

5.3.1 Summary of the Issue

The unique susceptibility of northern Alberta soils to erosion from water, particularly in the Peace River Basin, has been increasingly evident for many years. Many flooding and erosion problems have developed which are progressively altering the landscape, causing hardships for agricultural producers and local communities. The problems of drainage and erosion are closely interrelated. Although soil erosion can, and does, occur in the absence of drainage activity, efforts to reduce farmland flooding and increase arable land areas by drainage have led to increased levels of soil erosion. The abundance of wetlands and problems with seasonal sheet flooding across much of northern Alberta have led to substantial interest in drainage as a means of improving agricultural productivity.

Drainage of agricultural land produces benefits to the farmer in the form of increased revenues from an expanded land base, improved field operation efficiencies, earlier spring seeding and reduced risk of crop loss. In areas of concentrated wetlands, and in areas susceptible to sheet flooding, on-farm drainage has been generally attractive to farm operators. However, drainage can result in the loss of wetland habitat, impacting wildlife and waterfowl in particular. In addition, improper drainage techniques can increase susceptibility to erosion and have a detrimental effect on land productivity as well as downstream water quality.

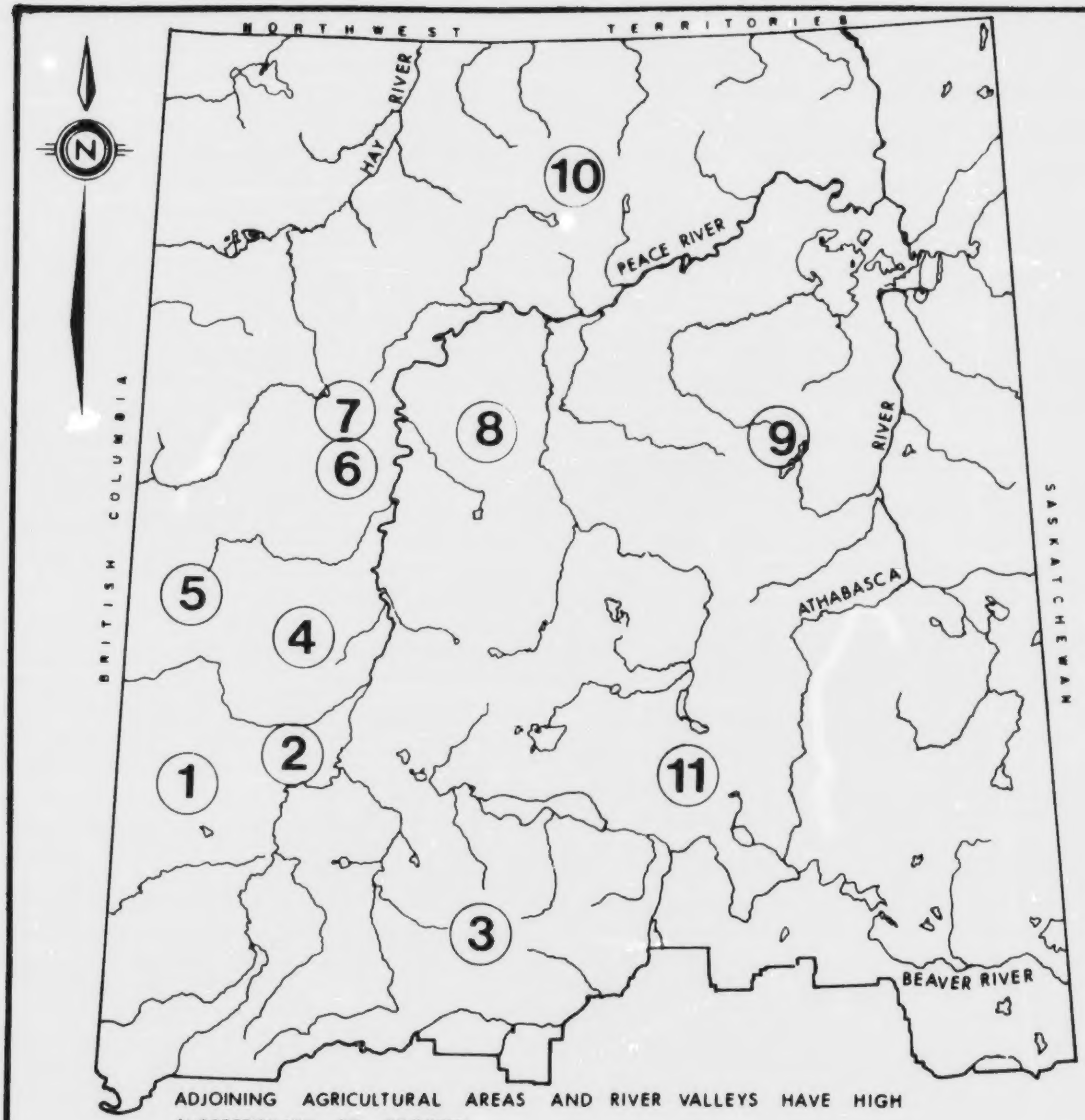
The clearing of land and construction of on-farm drainage works increases the rapidity and volume of runoff water. This occurs as the water does not have the opportunity to seep into the ground with time but has a more direct, faster route off the farm. With "clearing," the snow pack will also melt more rapidly as it becomes directly exposed to the sun's energy, thus increasing the peak runoff flows. These factors compound flooding, erosion and silt deposition problems farther downstream. The drainage of natural wet areas which serve as "retention" ponds also contributes to all of these problems as does the clearing of the land right up to the banks of the streams. With the increased flows entering the stream and resulting higher velocities, river regimes are changing resulting in new routes and increased erosion.

A major contributing factor to the erosion problem is the nature of soils in the northwest. Soils in this area are generally very fine silts and clays that can be easily suspended in water and carried away to be deposited elsewhere. Compounding the fine texture of the soils is the general presence of a "hardpan" substrata beneath the surface soils which limits the rate and volume of water that can percolate into the ground. Thus, a larger surface runoff volume occurs with significant rainfall events than would normally be expected based on the texture of the surface soils. This contributes significantly to the sheet water flooding phenomenon as well as to field and gully erosion.

The nature of the topography in northern Alberta also has a significant impact on the erosion problem. In many instances relatively high hills (Exhibit 5.3.1) slope steeply to very large flat plains which are deeply incised with river valleys. Consequently, with the clearing of the land, the runoff water comes off the hills very quickly onto the plains where it slows down due to the flat grade and causes flooding where adequate outlets do not exist. The water ultimately flows to the valley rim of the incised river channels and drops uncontrolled to the rivers creating large active erosion scars.

If erosion problems are left unattended, the extent and severity of the problem increases rapidly with minor erosion scars turning into deeply incised actively eroding gullies. The erosion leads to the loss of land, land access difficulties, safety hazards for both people and domestic animals, flooding problems and silt deposition endangering aquatic life and covering productive lands.

With the more rapid runoff, drainage of wet areas and subsequent decrease in inflow to the groundwater table, concern has been expressed that some waterways are "drying up" as groundwater discharge flows to these waterways are diminishing. Thus, if these streams are to be maintained, more rainfall has to occur (beyond man's control) or surplus water has to be retained during runoff events to augment or replace water supplies for domestic


NORTHWEST TERRITORIES
N
BRITISH COLUMBIA
SASKATCHEWAN
HAY RIVER
PEACE RIVER
RIVER
ATHABASCA
BEAVER RIVER
10
9
8
7
6
5
4
2
1
11
3

ADJOINING AGRICULTURAL AREAS AND RIVER VALLEYS HAVE HIGH SUSCEPTIBILITY TO EROSION.

① SADDLE HILLS	⑤ CLEAR HILLS	⑨ BIRCH MOUNTAINS
② BIRCH HILLS	⑥ HAWK HILLS	⑩ CARIBOU MOUNTAINS
③ SWAN HILLS	⑦ NAYLOR HILLS	⑪ PELICAN MOUNTAINS
④ WHITEMUD HILLS	⑧ BUFFALO HEAD HILLS	

AREAS OF HIGH ELEVATION IN NORTHERN ALBERTA EXHIBIT 5.3.1

and agricultural uses during drier periods. The development of retention areas would serve to reduce the volume and rate of runoff and provide downstream flow attenuation for a longer period of time.

Reduction of wildlife and waterfowl habitat is occurring as more and more drainage takes place. A key aspect of the issue of farmland drainage relates to the maintenance of wetlands and the benefits that may be derived from them. These benefits, which include wildlife values and groundwater recharge values, must be weighed against the alternative benefits that accrue to the farming sector from drainage as well as the costs of erosion control.

A final but very important concern centres on the deficiency of the provincial funds to fully rehabilitate existing drainage works or to implement numerous projects that the local authorities have identified as needing immediate attention.

5.3.2 Background Information

Hearings on the subject of erosion control in northwestern Alberta held in the mid-1970s by the Environment Conservation Authority (now the Environment Council of Alberta — ECA) resulted, among other things, in recommendations relating to the following:

i) planning and capital funding of drainage/erosion control;
ii) integrated land use, transportation and water resource planning;
iii) special recognition of the Northwest as an area of unique erosion problems;
iv) education and agricultural extension.

In response to the ECA report "Erosion of Land in Northwestern Alberta" (1976), a paper entitled "Interdepartmental Action Plan on Erosion Control in Northwestern Alberta" was released in 1978. The action plan outlined the following: the interdepartmental co-ordination to be implemented by five provincial departments; an enhanced funding formula for municipal projects; provision for 100% provincial funding of rehabilitation and major projects; and establishment of provincial and regional action committees on erosion (PACE, RACE).

By letter of agreement in 1985, Alberta Environment now handles all off-farm water management, including overall basin planning, while Alberta Agriculture provides services and programs for on-farm water management.

Alberta Environment administers the Alberta Water Management and Erosion Control Program, under which from $3.5 to $5.1 million has been provided annually in recent years to support drainage and erosion control projects in northwestern Alberta. Capital funding for new projects and funds for maintenance of existing projects is now provided under an 86/14 provincial to local authority cost sharing arrangement (Cost Sharing for Water Resources Management).

Alberta Agriculture provides technical and financial assistance to landowners for projects that prevent or control soil erosion (approximately $200,000 to $250,000 per annum provincially through the Soil Conservation Area Program) and for on-farm drainage and slough consolidation (approximately $100,000 per annum provincially through the Farmland Development and Reclamation Program). The department is active in promoting soil and water conservation practices. Alberta Forestry, Lands and Wildlife regulates the release of public lands to private disposition as well as leasehold use of public lands for agricultural purposes. The department applies caveats on sales and conditions on leases to minimize land development impacts on watercourses and water bodies.

Demands for provincial funds have increased substantially over the last decade. Drainage and erosion control projects are currently a high priority for northern local authorities. The demand for funding exceeds the budget available, resulting in a backlog of project applications. Costs to implement these projects are estimated to exceed $15 million. By comparison, provincial contributions to drainage and erosion control projects have been in the order of $3 to $5 million over the last four years (Exhibit 5.3.2).

Co-ordinated planning for drainage and erosion control is being implemented by Alberta Environment, in conjunction with a number of other departments, through the development of "Water Management Unit Plans" (WMUP). These plans are intended to provide an orderly framework for the implementation of drainage and erosion control projects. Developing a comprehensive drainage and erosion control program for northern Alberta would require a sizable additional infusion of public funds. The economic rationale for such support will require careful examination.

Where possible, the WMUP includes several drainage options for erosion protection and wildlife habitat preservation, including the following:

i) uncontrolled drainage with erosion protection;

ii) choked drainage — with restricted on-farm outlets creating temporary storage and reduced peak flows and velocities;

iii) slough consolidation — combining of sloughs/wetlands through drainage, both with and without wildlife habitat enhancement and possible irrigation or farm usage;

iv) natural water retention areas — recommendations for not draining unsuitable lands and storing runoff to reduce downstream peaks.

An integrated study of Alberta's agricultural land drainage potential has been completed by the Alberta Water Resources Commission, Alberta Environment, Alberta Agriculture, and Alberta Forestry, Lands and Wildlife. A report on this study is due for release shortly.

Exhibit 5.3.2
Provincial Contributions to Drainage and Erosion Control Projects in Northwestern Alberta:

Program	1985/86	1984/85	1983/84	1982/83
Provincial Projects*	$745,847	$942,454	$1,523,312	$1,790,067
			981,356**	290,000**
Cost Share Provincial/Municipal	2,083,170	1,198,196	321,655	1,212,852
Major Rehabs	1,472,477	612,588	691,901	965,063
Minor Rehabs	613,257	577,797	675,145	567,070
Maintenance	235,000	235,000	235,000	235,000
Total	$5,149,751	$3,566,025	$4,428,369	$5,060,052

* Not part of Northwestern Alberta Erosion Control Program.

** Heritage Trust Fund project at Slave Lake.

5.3.3 Key Concerns and Suggested Actions

The following key areas of concern related to farmland drainage and erosion have been identified:

- Land Use Planning, Control and Enforcement;
- Education and Program Delivery;
- Surface Water Retention;
- Program Funding.

Land Use Planning, Control and Enforcement

Discussions in the focus groups and workshops emphasized that land and water should be jointly managed. Long-term joint management plans that include consideration of the release of additional agricultural lands should be developed. It was also stressed that implementation and continuity of such plans should be co-ordinated with the development of transportation systems along with the preservation of wetlands and wildlife habitat. There is a definite need for a review of policies on the release of public lands, with special emphasis on protection of wet lowlands and erodable slopes. Solutions should be developed and implemented to mitigate existing problems on developed land. The following measures were suggested:

- Policies and criteria governing the release of Crown lands to agriculture should be reviewed. Water resource management must be emphasized in the criteria for land release. Farmers, local authorities and appropriate provincial agencies should all be involved in this review.
- There is a need for improved standards and controls on agricultural land clearing and land management in relation to drainage and erosion.
- Transportation planning and implementation should be more extensively integrated with land clearing, drainage and erosion protection planning.
- Remedial action for existing erosion problems on developed land should be formulated and implemented immediately. Adequate funding is the key constraint.
- Legal enforcement should include regulations or caveats on new patent and leasehold lands to ensure drainage is properly co-ordinated with other owners and agencies.
- Incentives should be provided for regional group initiatives that enable co-ordinated water management systems to be implemented that take all implications into account. There is a need for legal mechanisms to facilitate joint "multi-farm" projects.
- Incentives should be provided so that farmers or landowners can return farmland with conservation concerns back to its original (natural) state. Adequate funds should be set up whereby the "Crown" can buy back the land for conservation purposes.
- Co-ordination should be emphasized among all involved agencies, including interdepartmental (within government) and interagency (municipal, regional and provincial programs). Program implementation should be simplified with a "one-window" approach and local authorities must be involved in the planning process.

Education and Program Delivery

The general consensus of focus groups and workshop sessions was that an information and education program was needed so that all parties could better understand how their actions pertaining to water and land management can affect others. Education, awareness and information exchange programs are required at the political level, within the public service, and throughout the general public with particular emphasis on the affected farming communities. The following measures were suggested:

- More extensive education should be provided to farmers on proper land and water management for long-term benefit. The opportunities for, and implications of, proper land and water management related to farming practices on erodable soils and slopes have to be identified and properly conveyed to farmers. The effectiveness of existing education programs should be reviewed and expanded where appropriate.
- Land owners, politicians, civil servants and agency personnel should be made aware of the need to have regulations and enforcement mechanisms set in place which do not allow improper practices or release of unsuitable lands.
- There is a need for simplification of the project application, review, approval and inspection process (e.g., with respect to

Alberta Environment cost sharing projects, Soil Conservation Area Program (SCAP) and Farmland Development & Reclamation Program (FDRP) projects. All participants should be thoroughly informed of the process. Present procedures are complex, complicated (require a multi-agency approach) and require a lengthy time before implementation can be approved. Procedures should be reviewed and streamlined where possible.

Surface Water Retention and Storage

Concern was expressed at all of the focus groups and both the workshop sessions that "we do not want to drain all of the water." Instances were cited that water tables were being lowered and streams were drying up. It was suggested that some of the drained water should be stored for domestic use, stockwatering, wildlife habitat enhancement and even for irrigation during low precipitation cycles. It was also noted that natural low wetlands and swamps that will never be suitable for agriculture should be maintained as natural water retention areas. These storage and natural water retention areas also assist in reducing flood peak flows during high runoff periods. Suggested actions include the following:

- Conservation policies and programs must be established to protect natural wetlands, wildlife and fish habitats. Criteria and procedures should be developed to ensure that these features are taken into account when considering drainage programs.
- Surface water retention, storage and consideration of wetland values should be included in major drainage works programs. Man-made water storage should be looked at as a possible alternative.
- Incentives are needed to encourage establishment of windbreaks or vegetative buffers along watercourses and to encourage retention of natural wetlands and consolidation ponds as water storage areas.
- As the north has a low annual precipitation and is close to being a semi-arid area, the long-term impacts of draining of wetlands on groundwater, surface water, soil loss, etc., requires addressing and further research.

Program Funding

Throughout all of the working sessions, concern was expressed that numerous drainage and erosion control projects require immediate implementation so that local situations do not deteriorate; thereby causing dramatically higher costs in the future. The problem is considered severe enough that several local authorities now rank drainage and erosion control expenditures second only to those needed for transportation services. It was stated that effective programs for dealing with the problem have now been developed but the missing ingredient is provincial funding. Over 50 drainage and erosion control projects have been identified by the local authorities that require immediate attention. These projects have either been approved for funding by the local authorities, or are presently being investigated. Local authorities cannot afford to initiate these projects without provincial assistance. The following actions were suggested on the question of financing:

- A strong political will is needed to implement this program on a scale which is sufficient to address identified problems.
- A long-term provincial commitment to funding is required but only after adequate planning and consultation have occurred.
- Establishment of a Provincial Drainage and Erosion Control Program complete with funding and scheduling for project implementation is suggested. Within such a program there should be criteria and standards established for implementation of projects with due consideration of environmental, social and economic factors.

5.4 Protection of Surface Water Quality

5.4.1 Summary of the Issue

Protection of surface water quality is a primary concern for northern Albertans. Strong concerns were expressed related to general contamination and the pollution of surface waters from agricultural chemicals, animal wastes, industrial and municipal effluents, and septic tank systems.

The quality of water affects the entire population and all water-related activities. On numerous occasions it was emphasized that there was a requirement for more intensive monitoring of water quality to ensure that regulations were being followed. Concerns related to monitoring included pollution from the following sources:

i) pulp mill effluents;
ii) discharges from cottage septic systems; and
iii) non-point sources (those without a concentrated or easily definable point of discharge) such as runoff from the use of agricultural chemicals.

Questions arose related to pulp mill effluents which could also be directed towards other effluent sources. Questions that were asked included: What effluents are being released? What is the pollutant? What are its constituents? How expensive would it be to clean up? Why does more froth appear on the river between 4:00 a.m. and 5:00 a.m.? How safe is the water to drink? Can something be done about cleaning up the color and odor problems on the Wapiti and Smoky Rivers? How much would that cost? Is our environment being sacrificed for industry and jobs? Why are industrial plants located close to rivers? Can't there be trade-offs or more balance in order to protect our environment? What are the long-term cumulative effects of adding industrial effluents to our rivers?

Much concern was also directed towards effluents being added to lakes and streams from individual septic systems. It was stated that there are a large number of improperly installed septic systems already in service and, although individually they are insignificant, cumulatively they add up to a major impact on water quality. Concerns were related both to the approval process as well as the lack of monitoring for these systems. As a result, systems have been improperly installed; instances were cited in which raw contaminants were entering surface waters directly as a result of improper operation. It was felt that some means of ensuring that procedures are being correctly followed must be put into place to protect surface water resources from the inflow of sewage contaminants. In areas of limited population, enforcement should be more co-ordinated and integrated to allow adequate monitoring and follow-up. Enforcement of standards and better monitoring of septic systems is needed. The perception of the public is that while it appears numerous government departments are involved in regulating septic systems, it is very difficult to determine who is responsible.

The use of farm fertilizers, chemical sprays and industrial spraying of power lines, oil and gas drilling sites, and spraying along seismic lines and roads concerns many citizens. Brush sprays used to sterilize soil were also mentioned. The following questions were asked: Which chemicals are being used? Who decides the need for spraying? What do these chemicals do to our water resources? How are they being regulated?

Empty chemical containers are often disposed of along watercourses. It was stated that more penalties are needed regarding improper disposal of chemical containers and that spraying of highly toxic brush killers should be banned. Dumping by fuel and oil trucks in road ditches particularly in oil rig moves was also mentioned as a concern. The Swan Hills Waste Management Plant was of special concern. Since it is on high ground, concerns were related to possible spills that might drain into watersheds. Assurance that a program will be set up to prevent contaminants from entering watersheds, including those entering accidently from trucks which allow chemicals to spill into the road ditches, is required. Assurances that enforcement and monitoring are effectively being carried out were also requested.

In general, the public would like to see research technology extended to ensure that all avenues have been explored to prevent the dumping of wastes into surface waters. The recycling and re-use of wastes was advocated. At numerous focus groups and workshops, participants stated that the government should be attempting to achieve zero discharge of wastes and effluents entering into streams and lakes. They feel that the existing policy of recognizing assimilative capacity should not be allowed to continue, particularly in instances where there are unknown long-term effects of wastes. The "Borrow Clean — Return Clean" theme was prevalent in several of the sessions.

The application of methoxychlor on the Athabasca River for black-fly control was specifically raised as an issue. Concerns were expressed regarding the long-term effects of the chemical on river water quality, aquatic insect life, bird populations which are dependent on insects for survival and eventually human health. As a result of concerns expressed by downstream communities, Alberta Environment is reviewing its policy on uses of methoxychlor for this purpose.

In summary, it was stated by participants that industry and jobs are needed, but in exchange we allow too much pollution and too many negative impacts on our environment. A strong political will is needed to ensure that our environment is safe for many generations to come. We must learn from mistakes such as those made in Europe and Ontario, and other areas that are now suffering from polluted rivers. It was suggested that more educational programs are required so the public will understand the effects of pollution and politicians will become more aware of the damage caused by chemicals and waste disposal into water systems.

5.4.2 Background Information

The primary responsibility for protection of water quality resides with Alberta Environment, principally through the authority of the Clean Water Act. Under this Act, the department carries out a number of activities related to water quality monitoring, effluent licensing, and enforcement of license conditions.

Alberta Environment has three permanent long-term water quality monitoring stations in northern Alberta. These are located at Dunvegan Bridge on the Peace River, Watino on the Smoky River, and Athabasca on the Athabasca River. Approximately 105 parameters are collected at each site on a quarterly basis, and 50 parameters, on a monthly basis. Data are available to the public. Environment Canada has a number of water quality monitoring stations at provincial and territorial border locations in northern Alberta (at Jasper Park and Embarras Portage on the Athabasca River, at Fitzgerald on the Slave River, and on the Hay River near the Northwest Territories border). The Prairie Provinces Water Board sponsors a monitoring station on the Beaver River at the Saskatchewan-Alberta border. Alberta is not currently a signatory party to the national water quality monitoring network, but shares water quality data with other jurisdictions.

Several specific studies of localized water quality concerns have been initiated in northern Alberta (e.g., Wapiti River, Athabasca River downstream of Fort McMurray). Additional studies have been sponsored as part of the Alberta Oil Sands Environmental Research Program (AOSERP). These studies, lasting from one to three years are conducted in order to establish baseline conditions and impact assessments.

The department also carries out lake surveys for baseline description and impact assessment. These surveys are typically one to two years in duration, with monthly sampling (examples in northern Alberta include Garner, Skeleton, Muriel Lakes). Long-term studies which examine a wide range of influences on lake quality have been conducted at Baptiste, Nakamun and Ethel Lakes in the north.

Alberta Environment reports that the following water quality assessment programs are either underway or proposed for northern Alberta.

i) Underway
  - Lower Athabasca River System survey: to better describe baseline conditions, address local concerns and support planning studies
  - Upper Athabasca River survey: to augment existing data base prior to pulp mill expansions
  - Calling Lake watershed: to describe baseline conditions prior to potential agricultural/industrial development
  - Smoky River surveys: to describe water quality conditions downstream of pulp mill and municipal effluents (report in preparation)
  - Peace River at B.C. border monitoring: to augment data base prior to pulp mill development
  - Hutch Lake impoundment study: baseline description and impact assessment (by Planning Division)

ii) Proposed
  - Pulp mill start up monitoring, where and when required
  - Peace River synoptic surveys (tentative 1988-89)
  - Smoky River re-survey (tentative 1989)
  - Northern lake surveys: Lesser Slave, Utikuma, Wabasca, etc. (as priorities permit)

Water quality overview assessments have been prepared for the Peace and Athabasca River Basins (Alberta Environment, Planning Division 1985a, 1985b). Results of these assessments are summarized in Exhibit 5.4.1. A water quality assessment was also conducted for the Beaver River Basin as part of the Cold Lake-Beaver River Water Management Study. Alberta Environment has also initiated a water quality baseline monitoring and modelling program on the Athabasca River.

Regulation and control of point source effluents is conducted by Alberta Environment under the Clean Water Act. The Act and Regulations prescribe the following:

i) licensing of waste-water discharges;
ii) requirements for self-monitoring and reporting;
iii) inspections and compliance surveys; and
iv) a hierarchy of enforcement mechanisms (e.g., directives, control orders, prosecution, stop orders).

Exhibit 5.4.2 shows in summary schematic form the primary instruments for regulation of water quality in Alberta.

The current system of licensing and controlling effluents is based on the application of the best practical technology, within the bounds of industry-specific and municipal effluent guidelines. Licensing of municipal sewer and water treatment facilities is carried out by the Standards and Approvals Division of Alberta Environment. Requirements for monitoring and reporting of waste-waters are stipulated in the licenses to operate.

The Pollution Control Division of Alberta Environment is responsible for monitoring industrial and municipal effluents and enforcing the Clean Water Act and its regulations. The ways and means by which the Division carries out its duties are summarized in "Approach to Pollution Control — Environment Enforcement Program" (Alberta Environment, Pollution Control Division, 1984). Industries and municipal waste treatment plant operators are required to provide monitoring reports on releases of wastes.

The Division conducts spot checks and compliance surveys to ensure the accuracy of monitoring methods, conformity with license requirements and status of waste treatment systems.

The Alberta Surface Water Quality Objectives (1977) provide quantitative values for desirable ambient water quality parameters. These values are intended to give "minimum water quality guidelines which would allow the most sensitive use." In some instances natural values for these parameters (i.e., unaffected by human activity) may exceed the desirable overall objectives.

Non-point sources of contamination (e.g., agricultural runoff) are the most difficult to monitor and control, since most such sources are unlicensed and subject to less direct methods of control.

Use of pest control chemicals on public and private land is regulated by the Agriculture Chemicals Act and Regulations, which Alberta Environment administers. Any herbicides used in Alberta must also be licensed under the Federal Pest Control Products Act, administered by Agriculture Canada. Before such licensing, products must undergo extensive environmental testing.

The Pesticide Chemicals Branch of Alberta Environment licenses, trains and regulates pesticide applicators and vendors. This branch also issues permits for application of restricted or experimental pesticides and for application of pesticides on, in or near water.

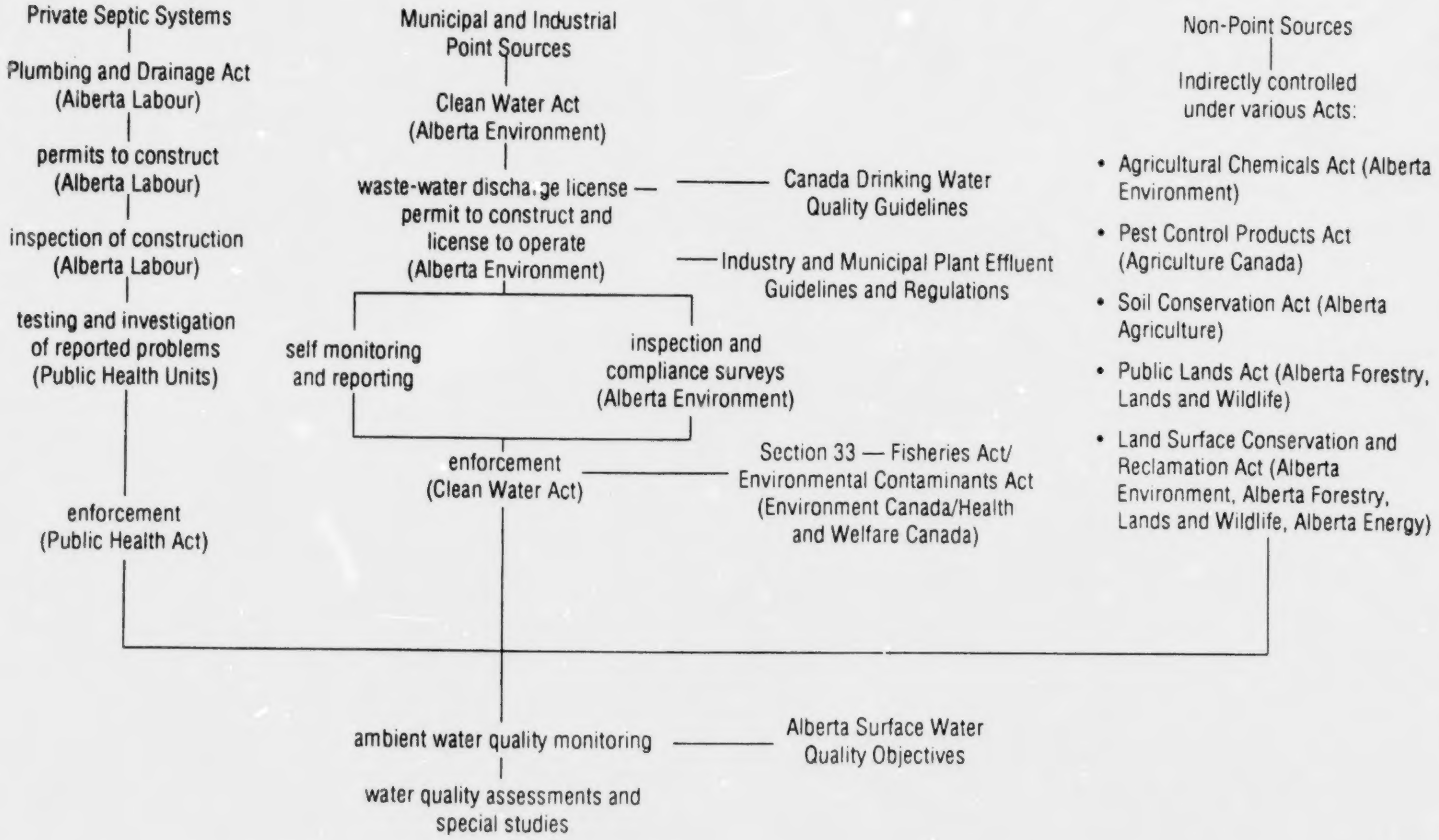
On public land, industrial disposition holders may apply pesticides on the area covered by their leases. They are not required to employ licensed pesticide applicators, although most do use contractors (under Alberta Environment's Pesticide Applicator Licensing Regulation).

Exhibit 5.4.1
Summary of Results — Water Quality Overview Assessments for Athabasca and Peace River Basins

Athabasca River	Peace River
- based on data from 3 fixed stations and 6 synoptic surveys (1984-85)	- based on historical monitoring data (1969-77) and 2 fixed stations
- except for point source, effluents from municipal and industrial plants have no broadly based influence on river water quality	- this area generally has a satisfactory and uncontaminated water supply
- many of the Alberta Surface Water Quality Objectives are regularly exceeded; however most excess is not attributable to point or non-point source impacts (i.e., is a result of natural inputs)	- however concentrations of phenolics (Smoky River) are high resulting in color and odor problems - iron concentrations in the Peace River and Smoky River are high, likely as a result of natural inputs
- the report recommends additional fixed-station monitoring, periodic synoptic surveys, collection of additional data for tributary streams and intensive studies of municipal discharge	- organic nitrogen and phosphorous concentrations exceeded objectives from March to September, likely resulting from natural runoff and fertilizer contamination
- the report also recommends that further work be conducted on trace organics (sampling, analysis, fate, modelling) to better understand the influence of tar sands activity	- the report recommends updated sampling of main rivers and tributaries and evaluation of entroplication potential for the Peace River

Sources: Alberta Environment, Planning Division
"Peace River Basin Water Quality Review" 1985
"Water Quality Overview of Athabasca River Basin" 1985

Exhibit 5.4.2
Regulation of Water Quality in Alberta — Primary Instruments


Private Septic Systems
Plumbing and Drainage Act (Alberta Labour)
permits to construct (Alberta Labour)
inspection of construction (Alberta Labour)
testing and investigation of reported problems (Public Health Units)
enforcement (Public Health Act)
Municipal and Industrial Point Sources
Clean Water Act (Alberta Environment)
waste-water discharge license — permit to construct and license to operate (Alberta Environment)
Canada Drinking Water Quality Guidelines
Industry and Municipal Plant Effluent Guidelines and Regulations
self monitoring and reporting
inspection and compliance surveys (Alberta Environment)
enforcement (Clean Water Act)
Section 33 — Fisheries Act/ Environmental Contaminants Act (Environment Canada/Health and Welfare Canada)
Non-Point Sources
Indirectly controlled under various Acts:
• Agricultural Chemicals Act (Alberta Environment)
• Pest Control Products Act (Agriculture Canada)
• Soil Conservation Act (Alberta Agriculture)
• Public Lands Act (Alberta Forestry, Lands and Wildlife)
• Land Surface Conservation and Reclamation Act (Alberta Environment, Alberta Forestry, Lands and Wildlife, Alberta Energy)
ambient water quality monitoring
Alberta Surface Water Quality Objectives
water quality assessments and special studies

Application of herbicides is regulated by the issuance of spraying permits in the Green Area (area of the province allocated for forestry). The Alberta Forest Service first introduced the permit system for the Green Area.

In order to minimize the possibility of contamination, the Agricultural Chemicals Act states that "no person shall discharge any pesticide or any substance containing a pesticide over an open body of water or within 30 horizontal metres of an open body of water, unless they have a permit to do so." These permits are issued by Alberta Environment.

There are probably some effects on fish populations from chemical runoff from farms, particularly from fertilizers. The effects are insidious and difficult to measure. Any increase in nitrogen or phosphorous into lakes or rivers will increase the algae growth and may result in winter-kill of fish in the smaller lakes. Alberta Fish and Wildlife have not definitely identified any such situations as they take many years to develop.

As far as other types of chemicals used on farms such as pesticides and herbicides, a report on the presence of 45 such chemicals in fish tissue for selected water bodies in Alberta was prepared by the Alberta Environment Centre. It was found that only 10 of the 45 chemicals could be detected in fish flesh and these were at very low levels. At present, farm chemical runoff is not considered a major problem affecting sportfish production.

Private dwelling sewage systems (septic systems) are regulated by plumbing inspectors under the Plumbing and Drainage Act administered by the Department of Labour. Cottage developments are issued permits under regional plans and land use zoning, enforced by the Regional Planning Commissions or Alberta Municipal Affairs. Local health units will test water for contamination (bacterial) when notified of a problem.

5.4.3 Key Concerns and Suggested Actions

The following key areas of concern were identified in relation to surface water quality:

- Public Education;
- Non-point Pollution (Agricultural Chemicals and Animal Wastes);
- Single-Point Pollution (Industrial and Municipal Effluents and Wastes);
- Stronger Regulations;
- More Extensive Monitoring and Enforcement.

Suggested actions for ensuring that good water quality programs are carried out in northern Alberta as related to the above concerns are outlined below.

Public Education

Discussion in the focus groups and the workshops emphasized that the public should be supplied with pertinent information so they will have a better appreciation of pollution damage on the environment. Educational programs should be directed toward both institutions and private individuals at all levels. Farmers should know more about the consequent damage involved using farm fertilizers, chemicals and pesticide sprays.

More technical advice should be made available to farmers on toxicity and the proper handling of chemicals and optimum amounts of fertilizer.

Suggested actions from conference delegates include the following:

- Emphasis should be placed on public awareness programs. The general public should be made aware of the existing regulations and their implications re effects on the environment and repercussions of violation.
- Educational programs at all school levels should be supported and encouraged. A pro-active approach to public education is needed.
- An environmental hot-line/information-line should be in place and widely publicized. With each inquiry, there should also be appropriate follow-up.

Non-Point Sources of Pollutants

Non-point sources of pollution include farm runoff, animal wastes, storm sewer runoff and numerous other scattered sources of pollution (e.g., road salts). In order to decrease or eliminate these sources of pollution, the following actions or programs were suggested:

- More research is required into non-point sources of pollutants such as fertilizers, pesticides, and herbicides. The general public and specifically users of possible pollutants should be made well aware of the hazards of non-point sources of pollutants and the measures and practices available to reduce their incidents and effects.
- Qualified assistance and financial support should be provided to farmers for proper use of agricultural chemicals and fertilizers.

This assistance should be related to soil type and crop rotation.

- Natural farming methods should be investigated in greater detail. Crop rotations, biological crop studies and the use of green manure should be included in the investigations. Financial incentives should be provided to assist in stimulating natural farming methods.
- Feedlots should not be located near watercourses. Incentives should be provided to move existing feedlots that are located near streams and lakes.
- A container refund program should be established to provide financial incentives for proper disposal of chemical containers.
- Although a policy of methoxychlor usage has been recently indicated by Alberta Environment, reinforcement and continuance of the policy is strongly advocated.

Single-Point Pollution (Industrial & Municipal Effluents & Wastes)

Single-point sources of pollution such as industrial and municipal effluents and wastes are generally the most easily controllable sources. As such they provide the best opportunity for increased research on waste recycling. Numerous focus groups and workshop participants stated that we should be heading in the direction of achieving zero discharge into our river systems from these pollutants. In order to achieve this, the following actions were suggested:

- Comprehensive environmental impact assessments (EIAs) are required prior to allowing development. Define what is affected, to what degree and to what extent the long-term downstream water users should be involved in these assessments.
- More research is required to identify methods to reduce or eliminate odor and color from pulp mill effluents, and fish tainting from oil sand effluents.
- Financial incentives to both industry and municipalities should be made available for improved treatment of wastes.
- Extensive research should be conducted into the means of waste treatment and disposal of effluents prior to the granting of approval of industrial expansions especially in the case of pulp mills and heavy oil sand developments.
- Monitoring data should be made available in a comprehensive, readable format to the public.
- Individual septic systems should be more rigidly inspected to ensure proper installation and more extensive monitoring should be carried out to enforce proper operation. Design standards should be reviewed and upgraded. Planning authorities in the sub-division approval system should recognize the need for operational septic systems and evaluate the proposals with high septic standards in mind. Public Health Units should be an integral part of the process.
- Laboratory testing facilities, possibly on a regional basis, should be available. The private sector should be encouraged to take on this function.

Stronger Policies and Regulations

It was agreed at all the focus groups and the workshops that stronger environmental controls were needed. It was stated that assimilative capacity should not be the entire means for allowing pollutants into our watercourses. It was the general consensus that regulation should be directed towards zero discharge of pollutants into streams, rivers and lakes. The following actions were suggested:

- The provincial policy directions should consider zero discharge and no recognition of assimilative capacity.
- Greater assistance should be provided to local authorities for proper installation and operation of sanitary landfills should not be located close to watercourses and existing drainage patterns should be taken into consideration.
- Greater political will is required for environmental protection. Both the economic and environmental implications of development should be taken into careful consideration in the decision-making process.
- Information should be gathered on an ongoing basis for updating of regulations. All standards should be based on sound current scientific information.
- Higher treatment and disposal standards should be developed with clear, concise and enforceable regulations. These regulations should be developed jointly with industry, government and the general public with due consideration to industrial costs but with protection of the environment as priority.

- Prior to committing lakes for recreational development, governments and local authorities should carry out sufficient tests and studies to ensure that water quality in lakes is suitable. Too often lakes are committed to recreation as a result of public pressure and later the lakes are found to be eutrophic or to contain leeches that cause "swimmers itch."

More Extensive Monitoring and Enforcement

Following development of public awareness programs and stronger regulations, participants at focus groups and workshops suggested that the following actions should be carried out to ensure that regulations would be properly adhered to:

- More funds should be made available to hire and train local monitoring and inspection personnel.
- Better sampling techniques should be developed and more extensive water quality monitoring programs carried out.
- There should be an equitable application and enforcement of regulations among water user groups.

5.5 Watershed and Wetlands Management

5.5.1 Summary of the Issue

Land and water resource management are inextricably interrelated. Water availability, flow and quality are affected by land use and land management practices. The issues examined in this section will focus on the implications of public land resource management policies and practices for water resources. In addition, particular attention is paid to the pressures being placed on, and the unique problems associated with, wetlands and shorelands.

Concerns regarding the impacts on water quality attributed to runoff from agricultural lands (e.g., nutrients contributing to lake eutrophication, contamination from agricultural chemicals) are examined in the section dealing with surface water quality Section 5.4. Effects of drainage and erosion occurring on private agricultural lands are examined in Section 5.3.

In northern Alberta, public lands have been extensively allocated and accessed for a number of purposes including geophysical exploration, forest harvesting, oil and gas drilling, pipeline and powerline right-of-ways, and cattle grazing. These activities require access roads and facility sites which result in surface disturbance and increased susceptibility to erosion.

The environmental impacts of forestry operations in Alberta were reviewed in 1977-78 by the Environment Council of Alberta. Forest operations in northern Alberta have in the past produced considerable erosion problems, some of which are in the forest areas while others, though originating in forest lands, manifest themselves in adjacent farming areas. Roads and skid trails in some of the harvested areas have eroded into gullies and abandoned clear-cut areas have contributed to problems of soil erosion and siltation.

In the Clear Hills area, clear-cutting caused large-scale flooding on the adjacent flat farm lands, thus severely damaging agricultural operations.

In situ oil sands development (Cold Lake, Grand Centre) and active areas of conventional oil and gas exploration and development, such as Red Earth, the Elmworth field and the Rainbow Lake area, are experiencing high concentration of surface activity and vegetation removal. Erosion problems are evident wherever the surface vegetation has been removed and no successful revegetation program was carried out.

The perception of wetlands as wastelands available for the conversion to more productive uses has caused large areas of wetlands across western Canada to be drained or filled for agricultural, transportation, industrial and urban uses. However, increased awareness of the importance of wetlands as wildlife habitat, recreational areas, and moderators of watershed hydrology has raised concerns over the preservation of wetlands in northern Alberta. The primary issue regarding wetlands is identification of a suitable mechanism by which desirable wetland habitat can be preserved or enhanced.

Wetlands consist of lakes, muskegs, swamps, marshes, and shallow open water areas. Historically, they have been perceived as lands having little value. It is now known that they have important ecological, hydrological, and recreational functions. Wetlands are valuable habitat for a wide range of wildlife and unique plant species. They also can play a crucial role in the hydrology of watersheds by moderating flood peaks and storm flows, recharging groundwater, modifying water quality, and buffering shorelines against erosion. Albertans also depend on wetlands for a wide range of recreation and educational opportunities. Wetlands were central to the establishment of Wood Buffalo National Park and offer excellent opportunities for observing ecological principles in natural ecosystems.

Wetlands can also provide direct economic benefits through the harvesting of wild rice, or horticultural peat and sphagnum mosses. Research into alternative Canadian energy sources has focused on the feasibility of developing wetland peat resources.

Recreation can preserve the natural condition of wetlands, or be a factor in their deterioration. Activities such as hunting, fishing, and bird-watching, are generally considered non-destructive uses of wetlands. However, recreational activities involving developments such as boating and cottage facilities or beach creation can be damaging.

Agricultural activity is the primary threat to wetlands. The conversion of wetlands on the southern prairies has long been important for expanding agricultural production. Through drainage, dyking and infilling of wetlands the agricultural resource base has been broadened and production efficiencies increased. This process represents the major potential threat to the wetland resources of the agricultural areas of northern Alberta, as the conversion process moves northward.

Agricultural activities also encroach on the shorelands of lakes and sloughs. Across large areas of northern Alberta, receding water levels have prompted the cultivation of shorelands. This activity has resulted in the destruction of habitat and has led to erosion. Unrestricted grazing activity around shorelands is also destroying the habitat and causing silting and waste contamination problems in the water resource.

A fundamental issue related to shoreland utilization is that of rights and ownership. Both shorelands and wetlands appear to be in a "grey area" in terms of planning, jurisdiction and legal authority.

5.5.2 Background Information

In the 1976 Environment Conservation Authority (ECA) Hearings on Erosion of Land in Northwestern Alberta and the 1977 ECA hearings on the Environmental Effects of Forestry Operations in Alberta, concerns were expressed over surface disturbances and erosion on non-agricultural lands. The reports of these hearings highlighted factors contributing to erosion of public lands and made recommendations for remedial actions and improved methods of control.

Areas of particular concern were highly erodable areas such as the Swan Hills, Hawk Hills and Birch Hills areas. The Swan Hills area has been under development for oil and gas production since the late 1950s. Due to the susceptibility of soils to erosion and the high degree of surface activity in the area, it became apparent that intensive erosion protection controls and remedial measures would be required. In 1972 the Swan Hills Management Steering Committee was established to develop and administer a program of research and control measures. Since that time extensive efforts have been made to control surface disturbance in the Swan Hills area. The Swan Hills case provides an example of the need to recognize water-related land use problems in advance and plan mitigative measures accordingly.

The Integrated Resource Planning (IRP) process addresses some of these needs. In the plans, specific objectives for watershed resources are defined to minimize erosion and its detrimental impacts on water bodies. Specific developmental guidelines are also suggested that focus on water resource protection. The plans encompass resource development activity in the planning regions but do not include urban development or water management. The IRP plans have no legal status and are subject to revisions or review at the discretion of the Minister of Forestry, Lands and Wildlife.

Policies and regulations regarding control of surface disturbance and erosion are implemented by a number of agencies, including Alberta Forestry Service, ERCB and Alberta Environment. These controls have become increasingly stringent over time as industrial pressures have increased and public demands for mitigation of impacts have strengthened.

The Land Reclamation Division of Alberta Environment administers the Land Surface Conservation and Reclamation Act and associated regulations. These regulations involve the review of applications for surface-disturbing activities and granting of conditional approvals to ensure that reclamation standards are achieved. The objective is to provide maximum practical protection for the maintenance of shores, watercourses, valleys, sensitive watersheds, alpine areas and rural lands. The act excludes residential sub-division, agriculture and timber harvesting.

Alberta Forestry, Lands and Wildlife has responsibility for management and administration of most provincial Crown land in Alberta under the Public Lands Act. Public land in the Green Zone is managed by the Alberta Forest Service (AFS).

Their responsibility is to control land use activities and minimize any negative impacts on water resources. To fulfill this role, the AFS has developed the Watershed Management Program which provides guidance in the areas of soil conservation and the protection of water bodies from siltation.

The Public Lands Division manages public lands in the White Zone of the province. Many of the programs for public land allocation have impacts on the watershed. One of their major responsibilities with respect to water resources relates to their control of the bed and shore of all permanent watercourses and water bodies. Strict operating conditions are placed on all non-agricultural dispositions to protect erosion-prone areas, watercourses and lake shores. Crown land suitable for agriculture is not sold, if subject to erosion, or adjacent to wetlands. Strict operating conditions are imposed on leases.

Forestry, Lands and Wildlife is responsible for watershed not water management; the latter area falls within the jurisdiction of Alberta Environment. The integration of these various responsibilities is through the planning departments of each agency, a variety of ad hoc task groups and day-to-day referrals on project proposals. More formal relationships are being developed.

A preliminary inventory of wetland areas was recently conducted as part of the Agriculture Land Base Study. The inventory was funded primarily by the Alberta Water Resources Commission and directed by an interdepartmental steering committee (Environment, Agriculture, Forestry, Lands and Wildlife). It is estimated that approximately 12 million acres of wetlands are found within the agricultural area (White Zone) of Alberta. Over 50% of this wetland area is located in the three basins examined in this study: Peace, Athabasca and Beaver. They currently constitute 30% of the White Zone in these basins but they are on the decline.

Several groups and agencies are involved in preserving and enhancing wetland areas: e.g., Ducks Unlimited, Alberta Environment, Habitat Canada, Alberta Fish and Wildlife (Bucks for Wildlife). Alberta Fish and Wildlife Division is a joint participant with Ducks Unlimited in the Wetlands for Tomorrow Program. Under the program, desirable wetland sites are identified for purchase, detailed management plans developed, and capital works installed where necessary to preserve or enhance wetland productivity.

At present there is no comprehensive wetland management policy in Alberta. However, the Environmental Council of Alberta recently adopted a resolution calling for such a policy.

The Lands Directorate and Canadian Wildlife Service, both agencies of Environment Canada, are active in identifying, classifying and monitoring wetland habitat across Canada. Localized monitoring studies are supported across Canada. Emphasis to date in western Canada has, however, been on conversion of sloughs and potholes in the plains area of the prairies. Migratory bird studies are carried out in such important areas as the Peace-Athabasca Delta.

Wildlife Habitat Canada is a privately financed foundation, initially funded by the federal government, devoted to wildlife habitat conservation, particularly wetlands. The foundation supports local agencies (primarily provincial) helping to fund wetland conservation projects.

In Alberta, to date, there have been few incentives for wetland protection, yet there are tax breaks for drainage and clearing. However, the Alberta government has advised the federal Environment Minister that Alberta will endorse the recently announced North American Waterfowl Management Plan, which proposes spending over $1 billion, during the next five years, in a joint U.S./Canada-sponsored habitat conversion program. The program will reimburse landowners for appropriate management practices by offering contracts to preserve wetlands and nesting cover. Such landowner agreements could involve reduced property taxes or other incentives to maintain cover essential to perpetuate waterfowl production capability.

The statutory planning agencies in northern Alberta (i.e., planning commissions and Alberta Municipal Affairs) have authority for establishing and enforcing land use by-laws related to shorelands and wetlands. The Land Use Branch of Alberta Environment assesses and evaluates major land use allocations including public land use assignments, sub-division developments and industrial sites. Particular attention is given to residential and cottage resort developments adjacent to water bodies. The Branch acts as a referral agency to the statutory planning agencies on compliance with the Land Conservation guidelines, susceptibility to flooding, bank and slope stability, erosion hazard, and surface drainage. The Branch also administers the "Regulated Lake Shoreland Development Operation Regulation." Under these regulations development of shorelands for industrial, recreational and residential purposes will not be allowed until a lake management plan and lake management land use by-law are in place.

Shorelands are unique due to:

i) their status under law regarding public access;
ii) their often transitory nature; and
iii) the fact that they provide a crossover between land use planning and water resources planning.

The Public Lands Act gives Alberta Forestry, Lands & Wildlife ownership of beds and shores of all watercourses and permanent water bodies. However, ownership of the land around lakes and watercourses is dependent on the wording of the landowner's title.

Legal access does not always exist to lake beds and shores or to Crown owned upland around lakes. The Department of Recreation and Parks and/or Fish and Wildlife Division may purchase or maintain public access sites to lakes or rivers with important fisheries or recreation value. Where land adjacent to a water body or watercourse is leased for agriculture, a public access site may be excluded from the lease if necessary. Under current land sale policies, Crown land next to water bodies is not sold except for approved sub-division. Sub-division plans provide for public access to lakeshores by means of environmental reserve, under the control of the local municipality.

Alberta has some critical wetland areas whose protection is the subject of wide concern. The Peace-Athabasca Delta represents a wetland resource of international significance. The biological resources of the delta provide food and income for the residents of Fort Chipewyan. Following construction of the W.A.C. Bennett Dam, alterations of flow regimes had a deleterious effect on seasonal wetlands in the delta. Weirs were subsequently constructed to correct this problem and water levels in Lake Athabasca and the delta have been restored to levels close to those existing before the dam.

World attention has been focused twice on the delta and its surrounding area. In 1985, the Wood Buffalo National Park was declared a World Heritage Site and was thus recognized as a key component of the world's natural and cultural heritage. The Peace-Athabasca Delta and the whooping crane nesting area in the northern portion of the park have also been internationally recognized as wetlands of world significance. A management evaluation of the delta has been completed and will soon be released.

5.5.3 Key Concerns and Suggested Actions

Northern residents identified a number of key concerns surrounding watershed and wetlands/shoreland management. The most important are:

- Integrated Land and Water Management/Planning;
- Control of Surface Distribution and Erosion on Public Lands;
- Conservation, Maintenance and Enhancement of Wetland Habitat;
- Access to and Ownership of Wetlands, Beds of Water Bodies and Shorelines;
- Public Awareness and Education.

Details of these concerns and suggested actions are described below.

Integrated Land and Water Management/Planning

There was considerable discussion at the workshops on the need for including both land and water management in one planning process with all interested and responsible parties, including the public, being involved. This need was also reflected in concerns over a lack of co-ordination among the various government departments involved in land and water management. Further concerns of significance centred on the release of marginal lands to agriculture and the process by which that land is authorized and released.

Suggested actions by conference delegates are:

- Lands that have conservational problems should not be released for agricultural usage.
- Co-ordination of government policies is required to avoid conflicts — e.g., clearing and drainage versus water retention.
- When land is released, natural watershed boundaries should be the criteria and not disjointed quarter section parcels.
- Prior to land release, there should be adequate study of both land and water implications. Local public involvement must be included in the process.
- The existing Integrated Resources Planning Process requires reinforcement; greater detail is required as well as stronger political will for more public involvement.
- Individual basin management planning should be extended across northern Alberta on an interdepartmental basis (e.g., similar to Beaver River Study);

- Integrated basin management should apply to both public and private lands.

Control of Surface Disturbance and Erosion on Public Lands

The workshop participants were aware that a variety of regulations and controls exist for all surface disturbances. At the same time, there was recognition that erosion and siltation problems continue to occur in areas experiencing resource development activities on both public and private lands.

To address this issue, the following suggestions were put forward:

- Tax incentives should be examined as a means to encourage conversion of marginal lands to an appropriate use (e.g., reforestation, grazing).
- The "roll back" technique for seismic lines, although expensive, should be considered as a requirement in specific areas.
- The hydrogeological impacts of clearing land need to be further investigated.
- Potentially sensitive grazing leases should be required to determine the applicability of reclamation (e.g., of surface disturbances arising from roads, drainage, cattle activity).
- Existing surface disturbance controls and regulations are actively supported by northerners; therefore implementation and enforcement should be assured.
- Emphasis should be given to the protection of public lands from surface disturbance and water quality degradation arising from forestry practices, motorized recreation vehicles, oil and gas facilities and seismic activities.

Conservation Maintenance and Enhancement of Wetland Habitat

There is a growing interest in and recognition of the value of wetlands in northern Alberta, not only as habitat for wildlife and the economy dependent on those resources but also for their important role in the hydrology of watersheds. Participants questioned the coverage and effectiveness of existing controls, and their enforcement, but were also interested in some positive incentives for wetland enhancement.

Specifically, conference delegates suggested:

- Compensation to landowners should be actively considered as a mechanism to conserve wetlands.
- There is a need to place a value on wetlands and have these values recognized in land and water planning and implemented through political will.
- Governments and responsible agencies should be pro-active in popularizing and implementing wetland conservation.
- Mechanisms should be put in place to encourage the retention of or to enhance wildlife habitat, particularly with respect to drainage and surface disturbance effects.
- A "no-net-loss" policy should be established with respect to wetlands because of fish and wildlife habitat concerns as well as the emerging interaction relationship between surface and groundwater.

Access and Ownership of Wetlands, Beds of Water Bodies and Shorelands

Considerable discussion centred on the ownership of shorelands adjoining agricultural lands. Public access to wetlands and shore lands for hunting and general recreation was also a major concern. Recreationists wanted reasonably free access while farmers insisted on their ability to protect their crops and cattle.

Conference delegates suggested the following actions:

- The ownership of shorelands, particularly with respect to adjoining agricultural and recreational lands, requires clarification and public awareness. The rights of landowners and leaseholds and the public need to be clarified.
- A program should be established to acquire public access to significant water-based recreation areas through designated corridors.
- Crown shorelines should be guaranteed appropriate access; shoreline vegetation should be maintained in the public access areas.
- Public education should be pursued to promote mutual respect of public and private shoreline rights.
- Procedures for Crown wetland disposition and conditions of use could be altered to provide seasonal access.

Public Awareness and Education

The participants recognized that sensitivity to environmental management is a relatively recent concern in our society. Many resource development, harvesting, and management practices have not kept pace with present social values. While this situation demands strict regulations and enforcement, it also requires a public that understands the nature of the problem, its potential impacts and what they can do to avoid or minimize it in their daily activities. Consequently, a number of suggestions were offered in this area by conference delegates:

- Effective farm management practices incorporating soil and water conservation should be promoted more intensively.
- Greater emphasis should be placed on raising the awareness and knowledge of local authorities and public with respect to integrated land and water management.
- Information on watershed management policies and practices should be broadly distributed to northerners; local involvement through discussion of projects and plans should be encouraged.

5.6 Farm and Rural Water Supply

5.6.1 Summary of the Issue

A considerable number of farms in northern Alberta are dependent on scarce, low quality water supplies derived from either dugouts or wells.

The availability and quality of water for domestic, stock watering and irrigation uses are highly variable across northern Alberta. The physical and economic constraints to providing an adequate water supply, as well as the limited opportunities for improving these supplies are matters of concern. In general, rural water systems are not subject to the rigorous standards and controls that are required by urban communities. As a result, long-term supplies are not guaranteed and the quality of water and possible effects on health are uncertain.

Numerous programs are currently in place which offer municipal water users both technical and financial assistance towards ensuring an adequate water supply. However, in the case of farming communities there appears to be an inequity in that very little assistance is available to ensure long-term high quality water supplies.

Several participants in the focus groups and the workshops expressed concerns regarding the quality of individual water supplies. It was noted that standards required in urban communities are not achieved on farms and that urban residents would never accept the poor quality water that farmers are expected to use. Where groundwater of suitable quality is not available and rural residents are totally dependent on capturing and storing limited surface runoff, farmers require technical and financial assistance to properly locate and construct dugouts or other storage and delivery facilities to ensure that when water is available it will be retained and that it is of suitable quality with no risk to health. In areas where groundwater is available there is concern for protection of aquifers to ensure a long-term high quality supply which is not affected by industrial withdrawals or the return of contaminants through deep-well disposal systems. Other concerns involve the loss of water wells as a result of seismic activity. Thus, there is a definite need to develop a program of assistance for farmers to ensure that they are able to obtain long-term high quality water supplies.

Workshop and focus group participants expressed interest in the development of regional systems with watering points as a main water source or as a back-up supply for the farming community; others preferred the independence of individual water supplies. There is no doubt that when a community supply pipeline is constructed, central watering points could accommodate farm needs for a back-up supply.

Several farming groups felt that further consideration should be given to the role of irrigation for future diversification of the agricultural economy in northern Alberta. Irrigation may benefit the area in the future but its potential use requires research on crop types, water needs, and costs.

Existing irrigation in the north is limited. Some use is made of drip systems for market gardens but the security of supply is uncertain. In this area, water sources have been put in place more for security of domestic and livestock water supplies than for complete irrigation.

Lack of upland water supplies and costs of high pump lifts will likely restrict irrigation development to lands which have close river access. This is likely true for the near future, although more research is needed to ascertain the ultimate potential for irrigation in northern Alberta.

5.6.2 Background Information

A special program for construction of water transmission facilities to farm areas encountering shortages was initiated in 1985 by the Alberta Department of Transportation and Utilities, Municipal Utilities Division.

The program entitled "Alberta Farm Water Grant Program" makes grants available to farmers and ranchers to assist in constructing water transmission facilities for domestic and stock watering purposes. The province cost shares with the participants on a 75/25 basis. The funding limit is based on $20,000 per serviced farm unit ($15,000 from government sources plus $5,000 from the owner). Applicants must be legally constituted farming or ranching groups or individuals, legitimate farmers or ranchers. Priority is given to those groups or individuals who can demonstrate an ongoing need. Projects are eligible for funding on a retroactive basis to April 1, 1985.

Projects to be funded consist of water transmission or distribution works which deliver to farm cisterns, dugouts or other storage works. Eligible project costs include those for all approved services, materials and labor required for the development of water transmission systems for domestic and stock watering uses, excluding land costs. Farmers desiring to construct systems for purposes other than for domestic and stock watering use are required to pay for such incremental costs.

This program which commenced in April 1985 runs for a three-year period terminating March 31, 1988, and is currently under review for a possible extension.

The provincial Transportation and Utilities Department works closely with the federal Prairie Farm Rehabilitation Administration on a number of rural community and farm projects. The two departments co-ordinate their efforts to ensure effective planning and cost sharing for each project. Several small communities have been successful in obtaining federal funds under the PFRA Rural Water Development Program for water pipeline projects to serve their agriculture needs. This program is also available to legally constituted groups of five or more farmers.

PFRA's primary role in farm water supply has been to provide technical and financial assistance to farmers for the development of on-farm water sources and irrigation projects; most specifically it deals with Farm Wells and the Dugout Program.

However, PFRA's guidelines are not always appropriate to farm water storage needs in the north and are currently under review for specific applications. The simple and inexpensive expansion or enhancement of existing natural storage sites may not be large enough to qualify for PFRA assistance, and therefore is not always eligible for funding. Consequently, these funding processes are perceived to be inequitable.

An individual water treatment system for farm use can cost between $2,000 and $4,000; however, there are no subsidies in place for water treatment as there are for urban communities. Provincial and PFRA funding programs do not provide money for water treatment or setting up individual treatment systems.

Farm operators also have difficulty obtaining advice, as well as information and inspection on their water supply systems. Farm water supplies are not tested regularly and test results are slow (i.e., three weeks to obtain results on farm water tests versus one week for urban communities).

Certain regions of northern Alberta may be subject to seasonal crop water shortages (e.g., Fort Vermilion). Engineering studies on northern irrigation have, in the past, emphasized the high cost of large volume lifts from the Peace River. However, Alberta Agriculture has recently conducted preliminary studies on small scale projects. The economic analyses resulting from these studies indicate that lower lift systems may be viable for most crop rotations in both the Peace River and Fort Vermilion districts, where the greatest moisture deficiencies have occurred. Irrigation would be highly effective for these districts in overcoming moisture deficiencies during crop germination and in affording the capability for second cuts of forage crops.

5.6.3. Key Concerns and Suggested Actions

The primary concerns related to farm water supply, as summarized from the focus group meetings and the workshop sessions, included the following:

- Protection of Groundwater Aquifers and Water Wells;
- Guidelines and Procedures for Obtaining Farm Water Supply Assistance;
- Education and Technical Assistance in Locating Potable Water Supplies.

Further explanation of these concerns and suggested actions by conference delegates are provided below.

Protection of Groundwater Aquifers and Water Wells

Specific concerns relate to seismic activity, oil and gas well drilling, development of oil and gas wells and deep-well disposal of industrial contaminants; all of which can affect groundwater quality and unless carefully controlled, contaminate groundwater sources. A number of people stated that seismic activity has caused loss of producing farm water wells. Much concern was also expressed about deep-well disposal and other drilling operations that can connect an uncontaminated aquifer with aquifers of poor quality, with consequent pollution of the high quality source. Frustration was also expressed when attempts were made to initiate a corrective process after a well is lost or polluted. Oftentimes the reception was quite negative, there was a large amount of bureaucratic red tape to overcome and the experience was very frustrating and often non-productive.

Farming communities readily admit that they do not understand the licensing and monitoring process and that more information and education is needed to assist them. It was also agreed that in regions where water supplies are scarce there is a need for additional rural group farm systems.

Suggested remedial actions include the following:

- Greater emphasis has to be placed on an improved groundwater data base. Problems related to water well losses associated with seismic and other drilling activities require more monitoring and closer scrutiny. There is a need for research into the reasons for well loss and the relationship to industrial activity.
- Review of standards, regulations and actual construction and monitoring methods related to deep-well disposal of contaminants should be conducted to ensure that good quality aquifers will not be contaminated now or in the future by these processes. Improved technology and research should be supported as they pertain to the problem.
- Establish public education programs which highlight the assistance and technical support available when wells are lost; the importance of water quality should be stressed in this program.

Guidelines and Procedures for Obtaining Farm Water Supply Assistance

Farmers are uncertain as to what standards or guidelines are necessary or acceptable to obtain assistance, grants or permits for on-farm water supply systems. It is clear that communities receive far more support and assistance than do individual farmers and rural residents.

Questions which have been asked include: Is a permit required? Is long-term supply guaranteed with a permit? Are grants or funding mechanisms available? Is technical assistance available? Is the quality of water acceptable with no health risk? Who issues the permits? Alberta Agriculture? Alberta Transportation and Utilities? Alberta Environment?

Applicants are faced with a maze of different government departments before the process can be approved and implemented. Statements were made that it takes two years to obtain a license for irrigation.

The following corrective measures were suggested:

- Equitable programs should be established for funding farm water supply and farm water treatment systems.
- A public education program should be developed to outline all of the existing procedures, requirements and technical and financial assistance programs that are available to obtain a reliable, good quality on-farm water supply.
- Long-term agronomic, environmental and economic research on the feasibility of irrigation for northern Alberta is required.

Education and Assistance in Locating Potable Water Supplies

The data base available on groundwater in government files should be made more readily available to the farmers, district agriculturists and water well drillers to assist in locating suitable good quality groundwater supplies. Where groundwater is not available, farmers require assistance in locating dugouts.

Farmers also need to be assisted in determining available water inflows, susceptibility of dugouts to leakage, and quality of the groundwater or stream which will feed the dugout. Water quality concerns are related to the effects of road salts and agricultural chemicals that may be carried into dugouts during spring flood flows or from upstream contamination. Where water supplies are short there was an expressed need to develop more group systems or to consider farm pipelines and joint multi-farm reservoirs, as an alternative to individual on-farm sources. The need to continue funding for the farm supply program was strongly expressed.

The following actions are suggested by conference delegates:

- Continue and upgrade the Alberta Farm Water Grant Program.
- Develop a better data base on groundwater including both quantity and quality. The data base should contain information on acquifer feed systems, drainage areas and effects of pumpouts.
- Provide more assistance in locating dugouts particularly siting to ensure ample water supply and good quality water. Government agencies should also provide drilling and geotechnical information to

ensure that the dugouts will hold water. Information on proper dugout operation and maintenance should be made broadly available to farmers.

- Better access to water quality testing facilities is needed. Turnaround time on water quality testing has to be decreased since it presently takes in excess of three weeks to test samples.

5.7 Tourism, Recreation and Fisheries

5.7.1 Summary of the Issue

Water resources with attractive recreational attributes and tourist generating capabilities are unevenly distributed across northern Alberta.

To the east, there is an abundance of high quality lake and river resources offering a diversity of recreational experiences. Dozens of lakes and river tributaries have excellent fishing resources, including trophy-size northern pike. Excellent beaches and swimming can be found, particularly in the Lakeland area, and numerous areas provide high quality canoeing, boating and sailing. A wide variety of opportunities exists ranging from intensive beach or boating activities to pristine wilderness recreation.

Poor access is a limiting factor to recreational activity in some areas, but in others, difficult access preserves the rugged wilderness quality of the resources. A significant issue arises where cottage developments, placed too close to lakes and rivers, preclude public access.

High quality recreational water resources are more limited on the western side of northern Alberta and there is a lack of water-related tourist destinations. Although the Peace, Smoky and Hay Rivers offer good boating and canoeing opportunities, lake-based recreation is generally confined to relatively shallow, moderate quality resources primarily serving local needs. Lesser Slave Lake is a notable exception providing excellent beaches and sport fishing opportunities.

With the limited availability of good quality resources, access to those resources that are available becomes very important. The current inaccessibility to potential recreation sites on the Peace and Smoky Rivers is of particular concern to northerners. Better access to lakes in the Slave Lake area and north is also a significant issue.

Throughout northern Alberta there is a growing demand for water-based recreation. Population growth in both north and central Alberta, as well as increased tourism, has put increasing recreational pressures on northern lakes and rivers, and the aquatic habitats provided by those resources. At the same time, agricultural, industrial and urban expansion has generated increased competition for those resources. One effect of this competition has been increased fertilizer, effluent and silt loading in rivers and lakes which are sometimes taxing the assimilative capacity of the water systems and reducing their recreational value. Coliform levels are rising in Lesser Slave Lake, agricultural runoff is contaminating Sturgeon Lake and sewage effluent problems from cottage developments are occurring in the Lakeland areas.

Industrial drilling activity and water withdrawals are also considered a factor in altering lake levels in the Cold Lake area. This instability is also detrimental to maintaining recreational values.

Concern has been expressed over the potential damage to fish eggs in Lesser Slave Lake from seismic blasts. However, research indicates that although explosions will kill fish by affecting the swim bladder, there is no known effect on fish eggs.

Resource diversity, regional abundance and shortage, increased competition from other users, and growing recreation and tourism demands characterize the recreational water resource environment in northern Alberta. Northerners want to see continued industrial growth. They also want to further diversify their economy through expanded tourism activity and to take full advantage of the range of water-based recreation opportunities afforded them. Their perspective is long-term. They realize that to ensure the availability of future opportunities, they must protect the resources. Maintaining water quality and lake level stability, protecting shorelines, protecting and enhancing fisheries habitat and populations, striking an acceptable balance between resource conservation and development are high priorities to northern Alberta residents.

5.7.2 Background Information

The overall resource capabilities for lake-based recreation vary from low in northwest Alberta to very high in the Lakeland area. River-based opportunities exist to a greater extent in the west but access is limited. .

There is an extreme shortage of lake-based recreation opportunities in proximity to communities in the northern part of the Peace River Basin. Those lakes that are available are subject to particularly high usage but have limited recreational capability. A number of lake stabilization projects have been carried out including Lac Cardinal and Winagami, but they have met with mixed success. There are a variety of technical limitations affecting the extent of resource enhancement that can be achieved, such as available runoff and feasibility of installing control structures.

Multiple use water storage projects such as Hutch Lake, near High Level, are in great demand. The project will create a lake suitable for recreation 6-1/2 miles long and 1/2 mile wide, and is presently being implemented. Lakes in north-central Alberta, draining into the Wabasca River are being made more accessible with recent road improvements in the area.

Improved access to the Peace River for recreational purposes is a high priority for local communities. A multi-agency inventory and planning process is currently underway featuring an integrated approach to the development and protection of the river valley. The plan focuses on site-specific recreation and tourism opportunities and the provision of access to the sites. It is a co-operative exercise involving both local and provincial government authorities.

Lesser Slave Lake presents a unique recreational resource supporting a wide range of recreational and tourism development opportunities. Consideration is currently being given to linking Hilliard's Bay and Lesser Slave Provincial Parks by a hiking trail with backcountry camping facilities along the northern shoreline. This development would provide further opportunities but would also create additional pressure to ensure that the water and beach areas were managed in an environmentally sound manner.

The eastern portion of the region contains some of the highest quality water-related regional recreation resources in Alberta. A sub-regional Integrated Resources Plan has recently been completed for the Lakeland areas. Consideration has been given to designation of the area as a destination recreation area or as a provincial park. The plan presents the Alberta Government's resource management policy for public lands and resources in the area. It is intended as a guide to resource managers, industry and the public having responsibility or interests in the area. The plan has no legal status. The guidelines do not include a plan for water resources but, by defining guidelines for activities such as cottage development, industrial development and grazing, they have implications for water management.

The plan would provide a spectrum of recreation opportunities ranging from intensive, highly serviced areas to extensive, wilderness recreation areas. If a decision was ever made to build a dam and reservoir on the Sand River, the plan would have to be altered.

Alberta Environment has just completed a water management study for the Cold Lake-Beaver Region. The study caused the initiation of licensing procedures to ensure that no additional withdrawals are made from May, Manatokan, Muriel, Reita or Tucker Lakes. They are to be used primarily for fish, wildlife and recreation.

Studies to identify water-based recreation and tourism opportunities in the Lac La Biche area have been completed and, at the same time, a comprehensive Lake Management Plan has been prepared for Lac La Biche. The plan was initiated after Alberta Environment placed Lac La Biche under the Regulated Lake Shoreland Development Operation Regulations. The plan defines land use and management policies for land and shorelines around the lake which guide and control developments to meet settlement, economic, recreation and environmental objectives.

Numerous "Lake Planning Framework" reports have been prepared by Alberta Municipal Affairs for regions of northeastern Alberta. They define and classify the lake resources in terms of their ability to support intense (recreation lakes), moderate (conservation lakes) or wilderness (preservation lakes) recreation activities. They do not have any legal status but are intended as a guide for local land use planning through the implementation of General Municipal Plans.

Lake and river-based recreation and tourism opportunities have been identified in Tourism Destination Area Studies completed for all the northern tourist zones. Carried out under the direction of Travel Alberta, these studies provide compendia of tourism development options; the destination area studies highlight the diverse opportunities for tourism in the north which are based on water resources. Examples include:

i) fishing lodges and guiding;

ii) riverboat cruises, jet boat tours (Peace, Athabasca and Smoky Rivers);
iii) adventure, historical, and environmental education tours of rivers and wetlands;
iv) lakeside resort accommodation;
v) full service campgrounds and cottage facilities;
vi) wilderness hiking and canoeing.

The federal government has recently established the Canadian Heritage Rivers System Program. With provincial and territorial governments, they are working on the development of the Canadian Heritage Rivers System. Rivers which are outstanding examples of Canada's natural heritage, which played a significant role in Canadian history or which offer outstanding opportunities for recreation could be designated "Canadian Heritage Rivers." Each river so designated will continue to be managed by the federal, provincial or territorial government in such a way that its distinctive heritage values and resources will be conserved, and increased opportunities for public use and enjoyment of the river will be provided.

The Clearwater River east of Fort McMurray and, possibly, other rivers or river stretches in northern Alberta would be suitable candidates for inclusion in this program. The Alberta government has declined to be involved directly in this program.

The federal government has also recently established a landmark policy for the protection and enhancement of fisheries habitat. The "no-net-loss" policy strives to balance unavoidable habitat losses with habitat replacement on a project-by-project basis. The principle is intended to guide responses to habitat damage but should not be interpreted as a statutory requirement to be met at all costs and in all circumstances.

The objectives of this program are essentially identical to those of the Habitat Branch of the Fish and Wildlife Division. The Division has stated that it supports a no-net-loss of habitat philosophy. The Fish and Wildlife Division is in the process of negotiating implementation of the federal policy in Alberta. The Division also supports fisheries habitat enhancement through its Bucks for Wildlife Program.

5.7.3 Key Concerns and Suggested Actions

The key recreation, tourism and fisheries concerns pertain to the long-term protection, enhancement and development of the area's water and fisheries resources. It is well recognized that those resources are critical to maintaining the northern lifestyle and diversifying its economy. The concerns more specifically relate to:

- Integrated Resource Planning — Land and Water-related;
- Water Quality;
- Resource Enhancement;
- Lake Level Management;
- Communication among Government Departments and with the Public.

Details of these concerns and suggested actions are outlined below.

Integrated Resource Planning

Workshop discussions identified concerns such as the need for a balance between intensive and wilderness recreation opportunities, recognition of the value of both consumptive and passive recreation activities, improved access to existing resources such as the Peace River Valley, and operating plans for wilderness areas as priorities to be addressed. They also identified the need for a completely integrated approach to resource planning. The IRP land use planning process, directed by Alberta Energy and Natural Resources, does not integrate water management, while the water planning process such as the Beaver River-Cold Lake Plan by Alberta Environment does not effectively include land use planning.

Suggested actions include:

- Combine the water management and land use planning into fully integrated basin planning for all northern basins. The co-ordination and co-operation of all government departments and the involvement of all communities affected would be critical to the process.
- Ensure public input requirements before changes are permitted in the water management/resource plans.
- Co-ordinate plans and regulations for both Crown and private lands.
- Emphasize wilderness recreation; develop a classification system and inventory of lakes and conduct more water framework studies.
- Lottery funds should be directed towards environmental research and development. The research could explore the relationship between economic development such as tourism and recreation and the environmental impacts and effects of such

developments. Thus this research would ensure the co-existence and maintenance of both economic development and the environment in a region.

Water Quality

All workshops identified the maintenance and improvement of water quality in northern lakes and rivers as a critically important issue. The importance of maintaining water quality to protect fisheries habitat was emphasized as were concerns over sewage problems in the Slave Lake area and cottage developments in the Lakeland area. Inadequate enforcement of existing regulations was considered a factor.

Suggested actions include:

- Encourage the use of land-based sewage disposal alternatives.
- Consider a borrow-clean, return-clean policy within the constraints of existing technology.
- Remove assimilative capacity of water resources as a consideration in water resources policies.
- Improve enforcement of existing sewage discharge and cottage regulations (health inspectors, consider rural by-law enforcement officers).
- Consider criminal legislation to charge individuals guilty of non-compliance.
- Permit the Minister responsible for an Act to lay charges.

Lake Level Management for Recreation

There was a strong feeling that lake level management did not give sufficient consideration to recreation needs, including campground areas and cabins. Also, in the eastern portion, concerns were expressed over the effects of drilling and oil extraction on lake levels. Discussions identified a lack of technical knowledge about the relationship between groundwater and surface water.

A number of suggestions were put forward at the conference, including:

- The government should take a more conservative approach to surface and groundwater disposition licenses until these two types of water interrelationships are much better understood.
- Greater emphasis and priority should be placed on the relationship between surface and groundwater.
- There should be improvement of existing lake level management structures.

Resource Enhancement

Residents have shown throughout this study a concern over the shortage of high quality water resources for recreation in some areas and over the loss of potential economic growth and diversification opportunities in other areas.

A lack of resources is considered important in the Peace River and Fort McMurray areas. It has spawned the recent multi-agency study into recreation sites in the Peace River Valley. Fisheries resources have been depleted in a number of lakes. Overfishing and possibly, water contamination are considered responsible.

Some suggestions offered included:

- Increased research and funding to identify, where appropriate, access to and development of new fishing and recreational sites in the north.
- Undertake extensive and reliable fisheries inventories throughout the north.
- Encourage small regional fish hatcheries and spawning habitat enhancement.
- Improve lake level management and maintain water quality at existing levels.
- In order to ensure management of our fisheries, specialized fish habitat technicians and biologists should be readily available on site.

Communication

There was a general concern about a lack of communication both among government departments and between government and the public. Workshop participants recognized the institutional complexity surrounding recreation and tourism but did not have a good understanding of who all the actors were or their roles. They were concerned also, that not all prevalent interests were being represented. Their concern centred on both the planning and regulatory aspects of the various government departments involved in land, water and fisheries habitat protection. Particular concern was expressed about the development process around lakeshores.

A number of suggestions were presented by delegates including:

- There must be closer liaison among provincial departments concerned with recreation and tourism.
- There must be improved liaison between provincial departments and local authorities.
- Clarification is needed for the public of the

roles and responsibilities of provincial departments.

- Public education emphasizing the importance of both the commercial and the sport fisheries should be conducted in conjunction with both parties through the appropriate associations and agencies.
- Develop procedures to minimize the "run around" and provide the public with easier access to the responsible officials. Departments should have more regional/local representation. A "one-stop" shopping concept was suggested, possibly with a toll-free number.

5.8 Industrial Water Use

5.8.1 Summary of the Issue

Northern Alberta has an abundance of natural resources, particularly forest and petroleum resources. Extraction and processing industries based on these resources are fundamental elements of the northern economic base. These industries require reliable sources of water to operate and have, where possible, been located on or near the relatively abundant sources contained in the major river courses of northern Alberta (Peace and Athabasca main stems). An exception to this norm are the in situ oil sands developments in the Cold Lake area where river volumes of the magnitude of the Peace and Athabasca are not locally available.

Measured in terms of either withdrawals or consumption, the use of water by industry is significantly greater than municipal, domestic and agricultural uses in all northern basins. Exhibit 5.8.1, although dated in terms of recent industrial developments, highlights the predominance of industrial water use relative to other sectors.

Throughout the public input sessions, concerns were expressed about three principal aspects of industrial water use.

Firstly, there is apprehension about the growing demand that industry is putting on both ground and surface water resources. Secondly, there are concerns regarding the existing or potential impacts of those demands on availability for other users. And thirdly, there are questions regarding the environmental effects of water use and waste-water discharges. A common element in all discussions was an expressed need for more public information on all aspects of industrial water use. Aspects of industrial water use related to effluents and water quality have been reviewed in Section 5.4 (Surface Water Quality). This topic will therefore not be included in the discussion to follow.

Concerns regarding industrial water use reflect the regional nature of industrial activity in northern Alberta. In the upper Peace River Basin concerns were expressed by community representatives and individuals that oil industry use of groundwater for enhanced recovery (waterflood) or projects could impact upon community and domestic wells. In the Cold Lake-Beaver River Basin concerns were focused on use of ground and surface waters for in situ oil recovery. Efficiency in water use was of particular importance. In the Athabasca River Basin, growth in the forestry industry and oil sands demands for water were of particular concern.

Exhibit 5.8.1
Water Withdrawals and Consumption — Northern Basins
(all data are expressed in 000 m³)

	Peace River Basin 1981			Athabasca River Basin 1981			Beaver River/Cold Lake Basin 1980		
	Withdrawal	Returns	Consumption	Withdrawal	Returns	Consumption	Withdrawal	Returns	Consumption
Industrial	52 272	28 038	24 234	178 160	126 250	51 910	2 010	—	2 010
Municipal)	12 122	8 336	3 786	12 400	9 920	2 480	3 390	2 590	800
Domestic)							1 125	40	1 085
Irrigation)	1 729		1 729	17 710	—	17 710	220	—	220
Agriculture)									
	66 123	36 374	29 749	208 270	136 170	72 100	6 745	2 630	4 115

SOURCE: "Water Use Study — Peace River Basin and Adjacent Northern Basins" 1984. Alta. Environment.
"Athabasca River Basin Water Use Assessment" 1982. Alta. Environment.
"Cold Lake/Beaver River Water Management Study" 1983. Alta. Environment.

An important component of the issue of industrial water quality is an understanding of the magnitude of industrial water use relative to the supplies available.

5.8.2 Background Information

The following paragraphs provide a brief description of current industrial water uses in relation to supplies within the study basins. Data on industrial water use are collected by Alberta Environment on a periodic survey basis using licensing records to establish the population of industrial users. All industrial users require a license to withdraw and utilize either surface or groundwater.

Present industrial water usage and consumption from the main stem of the Peace River and its major tributaries is insignificant in comparison to average annual flows. The largest industrial water user on the Peace River Basin is the Procter and Gamble pulp mill located on the Wapiti River at Grande Prairie.

The Grande Prairie pulp mill is presently licensed to withdraw approximately 40 million m^3 of water annually from the Wapiti River of which approximately 37 million m^3 are to be returned with water consumption amounting to only 4 million m^3. In 1986, the Procter and Gamble mill withdrew 32 million m^3 of water and returned 23 million m^3. By comparison, the average annual flow of the Wapiti River at Grande Prairie is approximately 3 billion m^3.

Other significant industrial uses of water in the basin include these related to the oil and gas industry: waterflood oil recovery, in situ oil sands recovery, and natural gas processing. Waterflood recovery occurs primarily in the southern tributary basins to the Peace River and in the Hay Lake/Zama Lake area. Consumption for all waterflood recovery projects is slightly in excess of that of the Grande Prairie pulp mill.

The Shell Peace River in situ oil sands plant has recently been expanded. The plant draws water from the Peace River for use in producing steam which is injected into the oil sands deposits to permit bitumen recovery. Water withdrawals for steam generation will average about 1.5 million m^3 per year, which is less than 0.1% of the river's minimum flow.

Gas processing plants typically use small amounts of water for cooling and processing steam.

In 1984, the total average annual industrial consumption in the Peace River Basin was 33 million m^3 which represents a fraction of 1% of the average annual flow of the Peace River at Peace Point, which is in excess of 66 billion m^3.

The main industrial water uses taken from the Athabasca River include forestry, mining and oil and gas operations. Suncor and Syncrude oil sands developments are the largest users of water in the basin. In 1986, the combined consumption of water from the Athabasca River by the two oil sands plants totalled approximately 67.5 million m^3, less than 2% of the total annual flow. Projected water requirements for a 20-year future development are only about 73 million m^3, which is comparable to current usage. This future projection allows for two more major oil sands plants as well as a major expansion at the Syncrude site. The minimal increase in future water demand is achieved based on improved efficiency of water use in the new plants and the phasing out of the Suncor plant. Presently, only Suncor is allowed to discharge return water back to the river. The Syncrude operation either consumes, recycles or stores in its tailings ponds any water that is withdrawn from the river.

The second largest industrial use of water in the Athabasca Basin is for waterflood oil recovery, which is conducted in the Swan Hills and area east of Lesser Slave Lake as well as fields in the upper basin outside of the NADC area. The third major industrial use is for pulp and paper operations including the St. Regis Alberta Ltd. Mill at Hinton and another mill under construction at Whitecourt.

The total average annual industrial consumption from the Athabasca River is approximately 140 million m^3, less than 1% of the average annual flow. Economic activity forecasts for the basin are currently being linked to water use projections.

The Cold Lake-Beaver River Basin is relatively small in area and water supply. Within the basin there are large industrial water demands arising from in situ oil recovery operations (principally Esso Cold Lake, BP Wolf Lake commercial scale operations and a number of pilot scale operations). Projected industrial water withdrawals for in situ use vary widely in proportion to forecasts of future bitumen production. The estimates published in the Cold Lake-Beaver River Water Management Study (Alberta Environment 1983) ranged from 14.5 million m^3 per year to 71.3 million m^3 per year by the year 2000. Total withdrawals by all user groups were projected to range from 22.9 million m^3 to 84.2 million m^3. These withdrawals compared with a calculated maximum available supply of 45.4 million m^3 from regulated lakes, rivers and groundwater. This amount of use would be approximately 3% of the average annual surface runoff from the two basins. Alberta Environment calculated that this supply could be increased to 111.6 million m^3 if Cold Lake was regulated. Concern regarding the potential impacts of withdrawals led to the formulation of a short-term plan which, in part, stipulated that:

i) all withdrawals up to a combined net depletion totalling 23.0 million m^3 will be met within the Cold Lake-Lower Beaver Basins (4.0 million m^3 from groundwater; up to 19.0 million m^3 from the Beaver River and selected lakes); and

ii) permits and licenses for withdrawal from lakes will contain minimum lake levels at which industrial withdrawals will be reduced or suspended.

Subsequent to announcement of the short-term plan, an assessment of long-term water supply alternatives was carried out culminating in the announcement of a long-term plan in 1985. Key aspects of this plan include:

i) Long-term industrial water needs for oil sands plants will be supplied by pipeline from the North Saskatchewan River.

ii) Oil sands water users are expected to collectively fund, own and operate the pipeline system in accordance with existing provincial statutes and regulations.

iii) The pipeline is expected to be fully operational by the time the limits of the local water sources are reached and by 1991 at the latest.

iv) All oil sands users with major withdrawals will be required to switch their source of supply to the pipeline when it becomes operational.

v) Withdrawal limits for surface water sources set out in the short-term plan will be strictly enforced.

vi) Withdrawal limits for groundwater sources will be set to include recently defined regional aquifers; withdrawals will be permitted on a site-specific and limited duration basis within these limits until the pipeline is operational.

vii) Increased recycling of produced water will be required.

viii) No oil sands surface water discharges in the Beaver River Basin will be permitted.

ix) Limits will be established for deep-well disposal.

Aspects of this long-term plan such as establishing subsurface disposal limits, groundwater withdrawal limits, and recycling requirements are currently under development by Alberta Environment.

Recycling of water used in in situ recovery is advantageous since it reduces the requirement for make-up fresh water and reduces the volumes of waste-water which must be disposed of through deep-wells. An objective that 100% of the produced water be recycled has been applied to date. Achievable recycling ratios are in fact dependent on the characteristics and variability of the produced water, the capabilities of emerging processing technologies to handle low quality water and the size of the in situ operation. New draft guidelines for in situ facilities define target recycling rates which are related to the total dissolved solids of produced water and recognize these other factors (Alberta Environment, November 1986). Overall, it is expected that 50% of water requirements will be met by recycled water. The interested reader is referred to a recent paper by Somani et al (1987) for further information on water recycling.

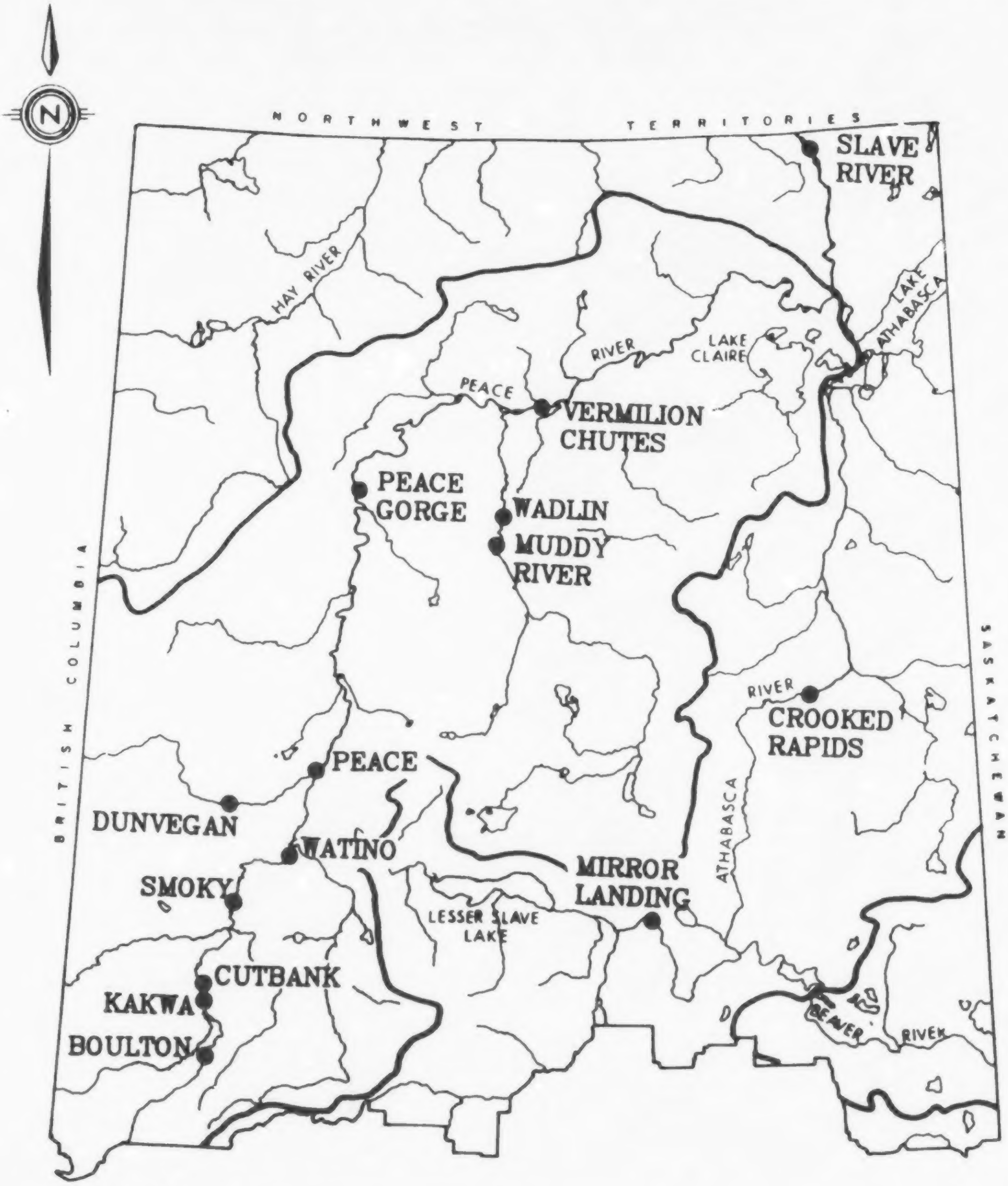
Further background information is provided on hydroelectric generation in northern Alberta and water flood oil recovery.

Hydroelectricity

There are currently no hydroelectric generating facilities within the Alberta portions of the Peace, Athabasca and Beaver River-Cold Lake Basins.

B.C. Hydro has constructed two hydro developments, the W.A.C. Bennett Dam and the Peace Canyon Plant on the Peace River located 12 miles downstream from the Bennett Dam in British Columbia. They are considering a third hydro dam, known as Site C, near Fort St. John. The construction of the Bennett Dam resulted in extensive damage to the ecology of the Peace-Athabasca Delta particularly when flow patterns were altered to fill the reservoir. Filling of future reservoirs could create additional problems.

Releases of water from the B.C. reservoirs have, in the past, led to problems of ice break-up, jamming, and difficulties in establishing ice bridges. Flows on the Peace River are now co-ordinated with the Province of British Columbia through the Alberta River Forecast Centre. A joint B.C.-Alberta Task Force was formed in


N
NORTHWEST TERRITORIES
SLAVE RIVER
HAY RIVER
LAKE ATHABASCA
RIVER
LAKE CLAIRE
PEACE
VERMILION CHUTES
PEACE GORGE
WADLIN
MUDDY RIVER
BRITISH COLUMBIA
SASKATCHEWAN
RIVER
CROOKED RAPIDS
PEACE
DUNVEGAN
WATINO
ATHABASCA
MIRROR LANDING
SMOKY
LESSER SLAVE LAKE
CUTBANK
KAKWA
BOULTON
BEAVER RIVER

SOURCE: NORTHERN ALBERTA DEVELOPMENT COUNCIL, "ECONOMIC DEVELOPMENT OPPORTUNITIES IN NORTHERN ALBERTA, OVERVIEW REPORT, 1985."

LEGEND

● HYDRO SITE

BASIN BOUNDARIES

POTENTIAL HYDROELECTRIC SITES
EXHIBIT 5.8.2

1974 to reduce the risk of ice-jamming by maintaining desirable flows during critical freeze-up and break-up periods.

A number of sites have been identified in northern Alberta as potential hydroelectric generating sites (Exhibit 5.8.2). The largest sites in terms of generating capacity are the Dunvegan (Peace River) and Slave River sites. The Dunvegan site was studied in 1975-76 by the Alberta government and proposals were received from Alberta private utilities in 1980 to develop a 41 metre high dam and 1 000 MW generating plant at the Dunvegan site. The proposed reservoir would cover about 3 100 hectares over a 130 kilo metre length at the river. For technical, environmental and economic reasons, the project has not proceeded.

Feasibility studies on the Slave River site were conducted in 1981-82. Although, an 1 800 MW facility was shown to be technically feasible, a number of environmental and costly engineering concerns came to the fore.

The project was about to undergo a joint federal/provincial environmental assessment process when economic conditions took a downturn in Alberta, shifting any requirement for additions to electrical generating capacity back at least a decade. Both the Dunvegan and Slave River sites are therefore not under active consideration for development.

Waterflood Oil Recovery

Water is commonly injected into oil reservoirs to supplement natural reservoir pressures and increase the recoverability of the crude oil in place. This process is commonly called "waterflood" secondary recovery and has been prevalent across much of the conventional oil bearing areas of northern Alberta (notably the Mitsue, Swan Hills, Judy Creek, Kaybob and Rainbow fields). It is a distinctly separate use from the in situ use previously discussed.

As oil yields from a reservoir decline, the proportional amount of "produced water" increases. This produced water is reinjected, thus resulting in declining needs for externally-sourced water. All external water used in waterflood projects is considered to be consumed since it is eventually left in the oil producing zone. Water consumption for waterflood recovery has totalled between 25 and 30 million m^3 in the Athabasca River Basin and between 10 and 20 million m^3 in the Peace River Basin. Total Alberta use in 1984 was estimated to be nearly 53 million m^3. Use in northern Alberta is therefore a significant portion of total provincial use. In the Athabasca River Basin approximately 90% of water supply for waterflood comes from surface water, the remainder from groundwater sources. In the Peace River Basin, supplies originate almost equally (50/50) from groundwater and surface water.

A new policy on the use of groundwater for oilfield injection is discussed in Section 5.1. As well, use of water for waterflood is projected to gradually decline over the next two decades (Alberta Environment 1984, 1982).

5.8.3 Key Concerns and Suggested Actions

Participants at the workshops and focus groups identified several areas of major concern with respect to industrial water use. To some extent these concerns overlap with those expressed during topical sessions on groundwater management and surface water quality. The concerns fell into five general groups:

- Public Access to Information and Complaint Process;
- Recycling;
- Groundwater Research and Groundwater — Surface Water Interactions;
- Water Availability and Allocation;
- Planning Processes.

Public Access to Information and Complaint Process

Participants voiced a common concern that information on industrial water use was not readily available to them or that they were not aware of how to obtain such information. The point was made as well that it was often difficult to identify the proper channels for having a concern related to industrial water use addressed. Conference delegates offered the following suggestions:

- There is a need for better public access and support in lodging and identifying problems. Some form of assistance to private citizens is suggested, possibly a toll-free telephone number. The key is follow-up on complaints by both industry and government.
- There is a need for more public information on water uses, including industrial water supplies and health risk information.
- There is a need for a central clearing house for water-related information and a central point of contact for problem referrals.

- Greater inter- and intra-governmental co-operation and co-ordination is required in order to clarify, and simplify the roles of government in regulating industrial water use.
- Environmental reports should be produced in language and format which can be easily understood by the lay reader.

Recycling

With respect to use of water for oil sands processing and in situ oil recovery, workshop and focus group attendees commented that it was difficult to understand why some companies were able to achieve higher water recycling efficiencies than others. Although the point was made that current economics make recycling favorable to companies, there was an expressed desire to have recycling requirements better defined. Suggested actions included the following:

- Industry should be required to use the best recycling technology available, within reasonable costs. Greater exchanges of information on recycling processes and technologies should be encouraged and facilitated among industries, government and the public.
- Financial measures such as a user-pay policy should be considered as a mechanism to increase water use efficiencies.
- Specific guidelines and targets for water recycling should be developed and performance in achieving targets monitored.
- The regulatory responsibility for stipulating recycling requirements should be clarified in the public mind.

Groundwater Research and Groundwater-Surface Water Interactions

Public concern regarding assurance of groundwater supplies and protection of surface waters from groundwater drawdown resulted in the following suggested actions:

- Greater emphasis should be given to collection of baseline groundwater inventory data and to research into groundwater-surface water interactions.
- There is a need to inform and educate the general public in regard to the interaction of ground and surface water.
- Given that disposal wells are in operation, greater surveillance and monitoring of disposal wells should be conducted and the information made available to the public.

Note: See Section 5.1 for further suggested actions regarding groundwater.

Water Availability and Allocation

There is a lack of public understanding of how water is defined as being available for industry use and how allocations to industry are set. The system of preferences and priorities established under the Water Resources Act and the manner in which these principles are implemented need to be conveyed to a broader audience.

Suggested actions include:

- Allocation criteria should be developed as part of the individual basin planning process. Consultation with all vested parties should take place prior to allocation. Regional needs and differences should be recognized.
- The availability and limitations of groundwater supply need to be better defined through improvement of resource inventory data.
- Instream flow and resource conservation requirements should be formally recognized in allocation procedures.
- There is a need for public clarification of priorities for water use.

Planning Processes

Contributors to the study identified a number of ways in which, from their point of view, the water resource planning process could be improved:

- There is a need for integrated land/water resource planning and co-ordinated policies and programs. Planning has to be done with the full involvement of all relevant land and water resource jurisdictions, local authorities and general public.
- Cumulative impacts of water withdrawals and waste discharges should be considered in the water resource planning process.
- Integrated resource planning should be done on the basis of watershed boundaries.

5.9 Native People's Concerns

5.9.1 Summary of the Issue

The fundamental underlying factor which shapes the views of Metis and Indian people in northern Alberta towards water is their belief in how people relate to their environment. The native people believe that man must see himself as an integral part of his surrounding environment and must always protect the balance in nature. This belief structure has very important implications in terms of water management issues, how they are defined and how they are resolved. This applies to both the quality and quantity of water.

The native people of northern Alberta have voiced strong concerns about the degradation of water quality, for example about the effects of methoxychlor on the water system and the population of feed insects for the waterfowl. Also the Suncor spill into the Athabasca in 1982 caused serious downstream effects on the taste and smell of the fish and forced the temporary closing of the Fort Chipewyan fish plant for the winter. Native people question whether controls are sufficient to ensure this won't happen again. Many people are also very disturbed by the possibility of contaminants being added to the Athabasca River by the Whitecourt pulp mill, when it comes on stream, and the possibility of serious contamination of the river if the dyke surrounding the Suncor tailings dam ever fails, as the tailings dam is on the shoreline of the river.

Maintenance of adequate downstream water volumes is also a major concern. For example, the construction of the Bennett Dam in British Columbia caused the water in the Peace-Athabasca Delta to drop by several feet. As a result, the annual spring flooding of the delta was eliminated and the drying up of the delta virtually eliminated the muskrat population and seriously altered the waterfowl habitat. The end result was a dramatic decrease in the economic viability of the community.

There are other concerns for fisheries and wildlife habitat, particularly conservation (Cold Lake, Wabasca/Desmarais) and the effects of siltation on commercial fisheries (Lac La Biche, Cold Lake, Lesser Slave Lake, and Utikuma Lake).

Many native people believe both the water quality problems and the water quantity problems that have occurred in the past indicate a lack of appreciation by non-natives of the need to work in harmony with their environment rather than exploit it.

The standard of sewer and water systems in native communities is also a very serious concern. Most of the remote communities in northern Alberta are Metis or Indian and typically have the most serious of the domestic water problems discussed in Section 5.3 above. The natural water quality in many of these communities is poor to begin with and poor sewer and water infrastructure exacerbates the problems. In many communities the water must be trucked in and, where wells do exist, they are often tainted because they are too close to sewage/septic overflows. The sewer and water infrastructure is often inadequate and poorly maintained, the latter because of the lack of trained operators and the difficulties of getting maintenance specialists into these remote communities. For example, water quality in Gift Lake has been deteriorating for the past several years, in part because the water plant and sewage lagoon is too small and some of the equipment is of poor quality. The water supply and sewage systems are presently being upgraded to dwellings in the Wabasca/Desmarais area even though the scattered nature of development results in very high costs.

5.9.2 Background Information

Water is a critical factor in all aspects of native life. The traditional aboriginal way of life involves living off the land: hunting, trapping, fishing and gathering. Most of the wildlife harvested by natives is directly dependent on the aquatic environment. Also fish is an important part of the family diet and commercial fishing and trapping are used to generate cash income.

But the link to the natural environment goes much deeper. Living off the land gives native people a sense of identity and self respect that is often not available from industrial or alternative economic activities. This sense of identity is directly linked to the belief that living in harmony with the environment is preferable to exploiting it.

It is important to note that most Metis and

Indian communities are not in the highest quality agricultural areas and therefore are more dependent on the traditional lifestyle. Moreover, most native reserves and settlements in northern Alberta are on water bodies. These communities are critically dependent on these water resources for their subsistence and commercial activities.

The native peoples have often suffered from the adverse effects of water resource development and from the abuse of water resources. A key example is when the Bennett Dam on the Peace River in British Columbia was completed, several native communities were affected including the Cree, Chipewyan and Metis people of the Peace-Athabasca Delta, hundreds of miles downstream. For several years when the dam was being filled, summer water levels in Lake Athabasca were 4 or 5 feet lower than usual. Fur trapping was almost wiped out and fish and wildlife were severely affected. Once the damage was done, remedial work such as experimental wild rice projects were constructed but the aquatic system has never been fully restored (Barton, 1987). A recently completed management evaluation of the delta will soon be released.

Legal Considerations

The prior occupation and use of land gives aboriginal title to the land and quite probably, the water that sustains it. This concept was recognized in the Constitution passed in 1982:

1. The existing aboriginal and treaty rights of the aboriginal peoples of Canada are hereby recognized and affirmed.
2. In this Act, aboriginal peoples in Canada includes the Indian, Inuit and Metis peoples of Canada.

There is an important legal question as to native rights to water that is adjacent to or flows through the reserves. First, there is a question whether native aboriginal rights were ever relinquished. Second, the treaties that established the reserves set aside the land so that the Indian bands could maintain their traditional lifestyle of trapping, hunting, and fishing, if they so desired. There is a strong implication that the agreements also included water of sufficient quantity and quality to maintain this lifestyle. Thus the native claims to water may supercede any alternative uses, although this can probably be confirmed only through the courts. Finally, some native groups are currently pursuing land claims agreements.

Jurisdiction

The British North America Act, in 1867, gave the federal government the jurisdiction to legislate lands reserved for Indians and the resources on the reserves. In addition, there are other small parcels of federal land — primarily the National Parks and land designated for military purposes. The rest of the land and the resources on it are the responsibility of the provincial governments. This has created a sharp distinction in terms of how community infrastructure projects are financed.

Indian-related decisions and policy are the responsibility of the Department of Indian and Northern Affairs Canada. The Department has a Capital Program that is designed to improve the standard of living on-reserve such that basic living conditions are similar to non-Indian communities of similar size and geographic locations. The mandate of the program is to assist Bands in planning, design and construction of capital projects to address the health, education and safety needs of the Reserve Community. Bands are to have maximum flexibility in determining local priorities and must submit a multi-year planning budget to the Department. Regional priorities are then established and projects initiated as funds become available from the Indian Affairs budgets.

Metis and non-Status Indians are not covered by the Indian Act and their communities are the responsibility of Alberta Municipal Affairs community infrastructure funding. Originally the Metis Water Supply Program was designed to provide potable water to the Metis settlements. This program was subsequently replaced by the Northern Water Supply Program which over the 1973-1980 period spent approximately $5 million on the construction of over 600 wells, six treatment plants and other facilities in northern Alberta. While not all of this was for Metis communities, they did benefit substantially from the program.

Support has continued throughout the eighties. For example, Alberta Municipal Affairs spent over $2 million in the 1985/86 fiscal year on the water and sewer program on the Metis settlements. This included full water distribution and sewage collection systems at Kikino and Big Prairie as well as water cisterns and septic tanks in the rural areas of most settlements.

5.9.3 Key Concerns and Suggested Actions

The native workshop was conducted very differently from the other workshops at the conference, by choice of the participants. Thus the recommendations which emerged were somewhat different in nature and context to what appeared in the Draft Technical Report. The participants worked through a process of identifying issues and concerns, and suggesting recommendations and actions. They did not work from the Technical Report but rather developed their own as a group.

Key Concerns

- native self-determination and involvement in decision-making processes;
- recognition of native rights and holistic approach taken to environmental issues;
- native safeguard of the environment;
- educational needs;
- preventive programs;
- community water supply and sewage systems;
- identification of environmental impacts — EIA process;
- reclamation and restoration projects;
- funding.

Suggested Actions

- Native people want greater input and involvement in decision-making processes. They wish to be able to control and input to their own destiny. Thus, it is important that native rights and holistic philosophies be recognized and that native peoples be invited to participate as equal partners in environmental committees, projects, etc.
- Native people would like the creation of an Aboriginal Environmental Task Force. The Task Force would address environmental issues and concerns from a native perspective.
- Both government and industry are encouraged to be sensitive to native lifestyles and philosophies. Both parties should consult and inform native communities and groups prior to developments and at initial stages of projects rather than later stages once the impacts have begun.
- Funding should be made available to native groups which would allow them to input to environmental issues and the decision-making process.
- Native people would like to see and assist in preventive programs. Alberta Environment is encouraged to emphasize preventive, educational programming which would stress protection and respect of the environment. Native groups would like to be part of and active in such programming.
- Recognizing that development will take place, native communities would like to be made aware of and consulted with, when developments will affect their communities and their lifestyles and livelihoods. Special channels of communication should be established in the case of emergency impacts brought on by accidental spills, etc.
- In order to preserve the present and maintain the future environment the use of herbicides and pesticides should be stopped.
- Small remote communities and Metis settlements should have a guarantee of water and sewage systems, in order to ensure the health of the members of the communities. Funding programs should be in place which would ensure adequate water supplies and system delivery. Once again communities should be consulted extensively in the planning for such systems to ensure the maximum community involvement and usage.
- Native people should be considered for employment on environmental projects.

5.10 Water Diversion

5.10.1 Summary of the Issue

The distribution and quality of the water supply in an area is not always adequate for the demands placed upon it. As the economy of a region develops, the demands for water grow and the competition among alternative uses intensifies. Canada has 9% of the world's fresh renewable water but 90% of our population lives within 150 miles of the U.S. border and 60% of the total discharge from Canadian rivers flows north.

Alberta's geography is such that the great majority of its streamflow passes through central and northern portions of the province, away from the primary population, industrial and agricultural centres. Consumption uses have accounted for between 15 and 40% of the annual discharge of the South Saskatchewan River Basin and have supported settlement and economic development in the southern one-third of the province. However, increasing water consumption for irrigation and increasing contamination are contributing to inadequate streamflows and poor water quality. Although Alberta has passed an average 83% of the basin flow to Saskatchewan over the past 15 years (33% more than required by agreement), future development will require hard choices concerning which tributary (Red Deer, Bow or Oldman Rivers), and for which uses, development will occur (Day, 1985).

Two possible strategies are available to augment water supplies: demand management and supply management. Demand management tends to increase private water costs but, possibly, reduces social costs associated with water allocations. Demand management includes such options as:

i) rational water pricing;
ii) recirculation; and
iii) improved water use technology.

Supply management, on the other hand, usually centres on the construction of control structures:

i) storage facilities to alter the timing of water availability;
ii) diversion structures to alter spatial availability.

The historical tendency in Alberta, Canada and throughout most of the world has been to solve water availability problems through supply management approaches. The long established pattern of local diversions within southern Alberta raises the speculation that potential future water shortages in the south will be met by diversions from northern rivers. This possibility is an important issue for northern Albertans.

The transfer of water from one basin to another sets up complex changes in the environmental, social and economic systems of both donor and receiving basins. Although a considerable number of diversion projects have been implemented throughout Canada and the rest of the world, the ability to predict the nature, direction and extent of these changes is extremely limited.

Uncertainties surrounding the implications of major water diversion coupled with fears that such diversions are being considered or even planned by government authorities is an important water management issue for northern Albertans.

5.10.2 Background Information

The most recent estimates place the total Canadian average annual flow involved in diversion at about 4 400 m^3/s about 4% of the average annual Canadian flow. Water transfer projects have occurred in virtually all provinces but the majority have been in British Columbia, Ontario and Alberta. On the other hand, the largest single projects have been in Quebec, Newfoundland and Manitoba:

i) Churchill Falls
ii) Lake Winnipeg, Churchill and Nelson Regulation and Diversion Project
iii) La Grande Project — Phase I

Alberta has nine diversion projects, all in the South Saskatchewan River Basin, transferring a total of 67 $m^3/sec.$ or 1.5% of the total diverted Canadian flow (Day, 1985). Most of these have been in the Bow River for irrigation purposes. None are considered major diversions: greater than 25 $m^3/sec.$

The possibility of importing water from basins north of the Bow and Oldman Rivers was assessed in the late 1960s in the Prairie Rivers Improvement, Management and Evaluation (PRIME) study. The idea was that as demands approached supply in the south, water would be transferred first from the Red Deer, then the North Saskatchewan and eventually the Peace and Athabasca Rivers. The projects suggested were similar to those in 1972 by the Saskatchewan — Nelson River Board (Canada West Foundation, 1982).

Numerous international diversion schemes have been put forward, primarily by private interests, since the early 1960s. Of these, the ones that would affect Alberta include:

i) Great Lakes — Pacific Waterways Plan (1963)
ii) Magnum Plan (1965)
iii) Kuiper Plan (1967)
iv) Central North American Water Project — CNAWP (1967)
v) North American Water and Power Alliance — NAWAPA (1964)
vi) North American Waters Master Plan — NAWAMP (1968)

Each of these schemes involved the Peace, Athabasca and North Saskatchewan River Basins.

Most of these schemes are intended to move water into the southwestern U.S., based on the premise that the area suffers, or will suffer from significant water shortages. However, a wide range of strategies is available to meet future needs without resorting to basin transfers. Given the exhorbitant costs of the proposed diversion schemes, both total costs as well as cost relative to the value of the transferred water and the probable environmental and social impacts, the desirability of these schemes is very low compared to the alternatives (Bocking, 1986).

To date, Canada has not exported significant quantities of water to the U.S. and it appears that the federal government, as well as the Alberta government, has no intention to do so.

In 1984, the federal Minister of the Environment reportedly stated that "we reject the contention that water is available for export. This will be a very important commodity for Canadians in the decades ahead. We, therefore, reject any such notion whether it comes from province, municipality or region in the north" (Scott, 1985).

The Alberta position is that "Alberta will not be part of any undertaking for the possible export of water beyond Canadian borders. The priority of water use and allocation is based firstly on provincial, secondly on interprovincial and finally on national considerations, and will not be influenced by international considerations" (Alberta Environment, n.d.).

The Alberta government position on interbasin transfers within Alberta, however, is less restrictive. "The waters in each major basin must be fully and efficiently utilized before interbasin augmentation could be considered" (Alberta Environment, Ibid.). "None of the major basins are fully allocated at this time and no studies are underway which contemplate transferring water from one basin to another."

If, in the future, the government decides that interbasin transfer of water in Alberta should be a water management option to seriously consider, the necessary research and studies to document and make public all benefits and costs, including engineering, environmental and social problems and impact would have to be undertaken. To do this properly would take much time and would be expensive. However, only after adequate information is in hand and has been fully assessed could it be determined whether or not interbasin transfer of water would be in the overall provincial interest.

5.10.3 Key Concerns and Suggested Actions

The concern of northern Albertans is that government policy leaves the door open for future diversions and that the rationale for justifying that diversion appears based only on the needs of the receiving basin. Focus group and workshop discussions centred on potential economic, social and environmental concerns. The suggested actions were not specific but, rather, all encompassing. These are described, therefore, after all concerns are discussed. The concerns can be summarized as:

- high economic costs;
- environmental damage;
- social considerations.

High Economic Costs

The economic concerns centred on the high capital cost of diversion facilities and the associated high costs of irrigation water in southern Alberta. These two factors were expected to require water subsidies for southern farmers and result in higher taxes for all Albertans. In addition, participants were concerned about the possibility of losing the economic benefits of using the Mackenzie River as a supply route and felt that diversions could reduce future economic development options and opportunities in the north.

Environmental Damage

The major environmentally related concerns involved the possibility of diversion resulting in a delay in ice break-ups and associated climatic effects, the potential interchanges of undesirable fish species and associated impacts, impacts on beaver and muskrat populations and the potential for further salinization of southern Alberta soils from expanded irrigation with associated runoff and river pollution problems.

Social Considerations

The primary social considerations of concern to participants were linked to the environmental damage. Lifestyle changes imposed by the reduction of fish and wildlife resources was of concern to both native and non-native northerners.

Suggested actions by conference delegates are:

- Northern Albertans are not in favor of interbasin transfers of water from Alberta basins. Therefore it is recommended that interbasin transfers not take place. The impacts associated with major interbasin transfers raise unique problems requiring special considerations and research. The impacts are not only social, economic and environmental in nature, but could also be global. Until these issues have been fully addressed and analyzed, northern Albertans would like extreme caution exercised.
- In light of the opposition to interbasin transfers and the need for water in arid areas, research into new technologies and conservation methods should be developed. Increased efficiency and the discouraging of waste in water systems is advocated.

6.0 Common Themes

The following sections provide the consultants' perspectives on a number of common themes which were identified in the course of public consultation, background review and consideration of the specific issue topics described in Section 5.0.

These themes represent aspects of the identified issues which were clearly similar in nature and indicative of predominant general trends in the comments and suggestions put forward by northerners.

At the conference, delegates discussed these themes in small workshops and developed a number of suggested actions. The workshop suggestions are presented below following the consultants' observations on each issue.

6.1 Integrated Planning and Program Co-ordination

A central and dominant theme which was evident in public input on many issues was the need for integrated planning of land and water resources and a greater degree of program co-ordination. Although these points can be thought of in separate terms there is an interconnection of planning activity and program implementation.

6.1.1 Integrated Planning

The term "integrated planning" had many interpretations encompassing integration of planning activities for land and water, for private and public lands, and for groundwater and surface water. The principal point being made was that resource planning had to incorporate and reflect all aspects of the hydrologic cycle; for example, that land use planning could not be carried out in isolation from water resource planning, and that the groundwater resource was tied to land use activities and surface water retention.

Within the context of integrated planning the following further points were made:

i) Both land and water resource planning should be conducted on a catchment basin basis.
ii) Integrated basin planning should have meaningful involvement from all existing and potential resource users; local authorities, community representatives and the general public should be actively involved.
iii) The cumulative impacts of resource allocation and regulation decisions should be considered from a long-term perspective.
iv) Consideration in water resource planning should be given to all uses including conservation and in-stream flow maintenance.

There is a general feeling that leadership is required to ensure the protection of water resource qualities and quantities through adequate advance planning, tied to co-ordinated program delivery and consistent implementation and enforcement of policies.

The Cold Lake-Beaver River Management Study and planning process was cited as a good example of efforts being made to take a comprehensive approach to basin planning, incorporating the often disparate and conflicting points of view of different resource user groups. It was suggested that such a process should be extended to other northern basins.

Considerable discussion occurred around the status of such comprehensive plans. Questions asked included: Are such plans enforceable in law? Should they be subject to revision, and under what conditions? How can implementation be monitored and ensured?

There was general discussion, as well, regarding the roles and responsibilities of existing planning agencies. A number of agencies are currently involved in water and land resource planning in northern Alberta. Included are the following:

i) Planning Division, Alberta Environment;
ii) Regional Planning Commissions (Mackenzie, South Peace, Yellowhead);
iii) Planning Services Division, Alberta Municipal Affairs;
iv) Resource Evaluation and Planning Division (REAP), Alberta Forestry, Lands and Wildlife;
v) Municipal Councils;
vi) Resource Planning Division, Alberta Agriculture.

In addition there are several federal-provincial committees and working groups working on various aspects of water resources management in Alberta and at Alberta's border, notably:

i) Mackenzie River Basin Committee;
ii) Peace-Athabasca Delta Implementation Committee;
iii) Prairie Provinces Water Board.

The Planning Division of Alberta Environment has the primary legislated mandate for water resource planning in Alberta. The Division carries out a wide range of research and problem-oriented planning within northern Alberta basins. With the exception of the Cold Lake-Beaver River Study there are no comprehensive lake or river basin plans currently in place. The resources necessary to prepare and implement such plans within a reasonably short time-horizon are not available. Considerable emphasis has, however, been placed on a medium-term program to implement sub-basin water management plans in the Peace River Basin, incorporating substantial local input.

The Alberta Water Resources Commission has the mandate to assess and review long-term water resources planning by the Government of Alberta in relation to agricultural, economic, community and environmental factors in Alberta. The Commission provides financial resources for conducting water resources investigations and may convene public hearings on water resource issues. The Commission has very limited internal research capabilities and must rely on co-ordinated efforts with other departments.

The Integrated Resource Planning process implemented by REAP was cited by public contributors as an example of how multiple demands on resources can be reconciled. The IRP process was, however, considered to have been somewhat weak in the past in its degree of local involvement and in its incorporation of water resource, as opposed to land resource, planning. The resulting plans are guidelines which apply only to public lands. The current IRP for the recreational development of the Peace River Valley has substantial input from local authorities.

In reviewing the land use principles, guidelines, by-laws and plans prepared at the regional plan and general municipal plan levels, it was apparent to the consultants that, where such plans are complete and approved, there is substantial consideration given to protection of watercourses through land use by-laws. The public perspective, however, is that these by-laws are not actively enforced.

The Lac La Biche Lake Management Plan (Alberta Municipal Affairs) is an excellent example of how land and water resource planning can be achieved with a high degree of local input. The Plan has statutory authority for land uses only; authority for water management resides with Alberta Environment rather than the local authority. Alberta Municipal Affairs, within the assigned planning jurisdiction of northeast Alberta, has also prepared a number of Lake Planning Frameworks; these frameworks establish a classification for lakes based on their resource attributes and capabilities to support development and provide guidance to local authorities in issuing sub-division approvals.

The purpose in highlighting these planning activities is to demonstrate the multiplicity of planning activities that is currently carried out which has some bearing on water resources. The comprehensive integration of land and water resource planning on a basin basis would require substantial restructuring of existing planning approaches and augmentation of planning resources, particularly within the leading water resource agency, Alberta Environment.

6.1.2 Program Co-ordination

The need for greater program co-ordination was a second theme which was common to discussions in a wide range of issues. A number of areas were noted by participants where several government agencies have responsibilities and where the program delivery roles of the agencies are unclear from the public perspective:

Area	Agencies
- problem response and referral related to oil and gas activity	- ERCB, Environment, Forestry, Lands and Wildlife
- public education	- Agriculture, Environment, Forestry, Lands and Wildlife
- farm water supply	- Agriculture, Utilities, Environment, PFRA
- water quality	- Health Units, Environment, Labour (plumbing inspectors)

In response to the multiple roles observed, the suggestion was often made that a "one-window" approach to water resource planning, allocation, program delivery, and enforcement be adopted.

While recognizing the value of such an approach, it appears to the consultants that much could initially be gained by a centralized dissemination of clear information on the existing agency roles and responsibilities rather than adding a bureaucratic level which would attempt to cut across existing legislated mandates. Certainly there would be room for an internal review and clarification of existing roles prior to dissemination of information to the public.

6.1.3 Suggested Actions

The discussion among conference delegates centred on how the public and government can improve the water management and planning process in northern Alberta. The following suggestions are submitted:

- Integrated multiple resource planning must take place involving all levels of government, the public and industry. Planning should take place on a regional basis.
- Planning for resource utilization must consider all land and water use options.
- Education and communication is required among governments, the public and industry, throughout the entire planning process.
- The decision-making process must be decentralized and experts must be made available at the local level.
- The public must be involved early in the planning process and provided with understandable and easily accessible information.
- Compensation should be available to those suffering damages.
- Government departments should work closer with regional planning commissions for integrated resource planning. Public access to information should be simplified.
- Upgrade information and awareness among government departments immediately for better understanding of the resource base and improved planning.

6.2 Monitoring and Enforcement

A common theme that predominated in all of the focus groups and the two public workshops was that more monitoring and stronger enforcement policies are required to protect the environment and, in particular, to safeguard the quality of water in rivers and lakes.

A key concern of northerners relates to the question of whether existing acts and regulations are adequate to ensure that there are reasonable levels of monitoring and enforcement. The public perception is that there are insufficient monitoring personnel in the field who are properly trained to carry out effective monitoring and enforcement, particularly with respect to water quality and land use regulations. There is also a perceived lack of co-ordination among the many government agencies that are involved in monitoring and enforcement. The impacts of cottage septic systems and seismic activity are examples where the public stated that it was difficult to determine who is responsible for enforcement.

In relation to groundwater the public has requested that field monitoring be increased. Field monitoring should add to the baseline data for both quantity and quality of groundwater. More observation wells should be added where groundwater sources could be affected by either withdrawals or contaminants. More monitoring of landfills and septic systems is suggested as a requirement to ensure that groundwater sources are not contaminated.

The fact that groundwater cannot be readily observed contributes to the demands for more sophisticated monitoring systems. The point was made that existing regulations on well abandonment need to be more rigorously enforced and that such regulations should be extended to include domestic wells. In addition it was suggested that unregistered abandoned wells should be identified and sealed and that all domestic wells be registered. Given the large number of active or abandoned domestic wells across northern Alberta this task would require sizable financial and manpower resources.

It was suggested that release of public lands, and unlicensed drainage and diversion activities need closer monitoring. Enforcement of existing land use restrictions was seen as a way in which problems of siltation, erosion, animal waste contamination and shoreline encroachment could be reduced. Local authorities and Alberta Public Lands have key roles in this regard. The comment was made that local authorities lack adequate by-law enforcement personnel to do this job adequately and that enforcement of land use by-laws is often politically unpopular at the local level.

The public wants assurance that programs are being set up to acceptably limit contamination of watersheds including those arising from agricultural runoff, chemical spills and industrial herbicides. Tracking and monitoring of these contaminants and information on their fate in soils and water is necessary from the public point of view.

There is a general demand for more monitoring of industrial effluents, more control of effluents and stronger enforcement of discharge regulations. The view was commonly expressed that higher treatment and disposal standards should be developed with clear, concise and enforceable regulations; these regulations should be developed jointly by industry and government with due consideration to industrial costs but with protection of the environment as a priority. Furthermore it was stated that information should be gathered on an ongoing basis for updating of regulations and all standards should be based on sound, current, scientific information.

The technical capabilities to conduct adequate water quality monitoring were questioned in a number of instances, particularly with respect to the number of water quality monitoring stations, to the frequency of sampling and to the types of analyses conducted. Limits on laboratory capacities were mentioned as a constraint to effective monitoring.

In summary, the public has requested that more effective monitoring be carried out to protect water resources from contaminants and over-utilization. They have also stated that penalties imposed on polluters or offenders are not severe enough and should be strengthened in order to preserve the environment. On the other hand, the public has also stated that some form of incentive should be provided to encourage implementation of measures to reduce pollutants entering surface and groundwater bodies.

The main implication of these suggestions is that greater resources would be required to implement a greater degree of monitoring and enforcement: more people would have to be hired, more data gathered and more funding programs would be required. Laboratory facilities would have to be increased and/or made more productive. Agency roles and responsibilities would have to be more clearly identified and stronger legislation may be required to more strongly penalize those who do pollute or degrade the aquatic environment.

It appears that much could be gained by better informing northern Albertans of existing monitoring and enforcement activities. However to go beyond this better understanding of activities and achieve the desired levels of monitoring and enforcement, financial and organizational constraints must be overcome.

The conference delegates discussed improvements that could be made in water resources monitoring and enforcement. The suggestions include:

- All water legislation or regulations should be evaluated from time to time to determine if they remain appropriate to the changing conditions.
- Co-ordinated federal, provincial and municipal government monitoring of resource utilization is required on an ongoing, comprehensive basis.
- All federal, provincial and municipal legislation and regulations must emphasize education.
- There must be an increased desire among legislators and enforcement agencies at all levels, to enforce existing rules.
- Water quality and quantity legislation must place the onus of compliance on the individual.
- Monitoring information is needed by both government and the public, and this information must be accessible.
- The public must become more involved in the monitoring process through:
  - improved environmental education; and
  - reporting infractions to authorities.
- The legal system should be educated in environmental matters so that penalties will be scaled to the severity of the impact and loopholes will be plugged.
- More political will is required to prosecute violators. More authority should be given to inspectors. Better communication is required between enforcers and prosecutors. There is a need for clear guidelines within government departments.
- Who's responsible for what? Better information is needed on existing rules and guidelines. Contacts must be provided for the public to report violators.

- More lake, river and stream monitoring is required to determine quality and quantity levels, and better lab access must be provided to the public for water quality assessments.

6.3 Public Information and Education

Increased public awareness and education is another important theme running through many of the major water management issues defined by northern Albertans. In many cases, the public is seeking information and is having difficulty obtaining it. In other cases there is a need to educate the public to improve farming practices, minimize erosion problems, reduce water pollution and alter behavior in a variety of ways that will assist in improving water conditions in the north.

Groundwater management presents a number of problems that could be effectively addressed by improved public information. There is a recognized lack of monitoring information about groundwater contamination which makes it difficult for the public to assess the risks associated with various potentially contaminating activities. Public awareness programs were suggested to raise awareness of the need for residents to voluntarily test and monitor domestic wells. This approach, it was felt, would also be effective in encouraging greater public co-operation in the proper disposal of chemical containers, keeping them away from landfill disposals and minimizing the potential for leaching into aquifers.

There is also a great need to provide the public with better information on groundwater quantity and quality, and the interaction between groundwater and surface water. There is a need for technical information to be presented in non-technical terms and for a better information and problem referral system. To fulfill these needs, it was suggested that existing data be made available in layperson language and that a single convenient source of information be provided where the public can easily access information and, if necessary, lodge complaints. Alberta Environment and the oil industry should take lead roles in educating the public on technical matters related to groundwater-surface water interactions. In addition, there is a need to more broadly and effectively disseminate information on existing regulations and procedures to protect groundwater supplies. Brochures, along the lines of Alberta Environment's series on erosion control, the mass media and public libraries were suggested as vehicles for dissemination. Media advertising should also be used more extensively to create greater public awareness of the information sources available and of the complaint registration process with respect to industrial impacts on domestic wells.

Education also has a role to play in the provision of community water supply. There is a need to encourage greater domestic water conservation. This goal can be achieved by metering and user charges, but public relations and education programs aimed at reducing water waste can also be very effective. Workshop participants also concluded that greater public participation would help to improve the long-term planning and implementation of community water supply systems.

In the provision of farm water supplies, increased public education and awareness was deemed a very important element. There is considered to be a general lack of knowledge on the part of farmers with respect to standards, guidelines and other information about on-farm water supply systems. An effective public education program directed at how to obtain a reliable supply of good quality water is needed. A "one-point" contact source for information would make accessing the information more efficient.

Farmers need greater assistance in locating potable water supplies. This could be facilitated by providing initial water quality testing as part of the project approval process, providing better access to water testing facilities and shorter turnaround time for the testing process.

There is also a need for better farmer education with respect to farmland drainage and erosion. Existing education and extension programs should be reviewed and expanded where appropriate. Improved education services should be provided to farmers on proper land and water management for maximum long-term benefit. One source of this improved service would be enhanced communication among involved government departments and between departments and farmers.

A wide array of water quality concerns could also be addressed through improved educational approaches. There are widespread concerns over non-point pollution sources from farm runoff, animal wastes, storm sewers, sub-division sewage and other scattered sources. Widespread public awareness campaigns are needed and should be aimed at targets such as farmers (on the use of chemicals and fertilizers), school children (to give them general environmental awareness on the importance of water quality), and households (on the dangers of household chemicals, paints, sprays, etc.). In addition, special extension assistance should be provided to farmers on the proper use of agricultural chemicals and fertilizers, with particular attention to runoff problems and with problems associated with poor septic field locations and maintenance.

A related concern looks at the impacts of water contamination on aquatic habitats, species and recreational interests. The dependence of critical ecological or water systems needs to be the focus of our public education programs. The interrelation of land and water management also needs to be stressed. Local involvement in watershed planning through greater public participation is required, both in the original plans as well as during subsequent revisions.

An important aspect of watershed planning and wetlands management is the concern over shoreland ownership. There needs to be a program aimed at increasing public awareness of shoreland ownership and access rights. The public also needs a better understanding of who all the actors are in watershed planning, the roles and responsibilities of each, and how to obtain information on any aspect of the planning process. Greater public awareness of these aspects of watershed planning and management will improve public involvement and satisfaction in the process.

Water allocation priorities have been established by the Alberta Government but workshop and focus group participants indicated a general lack of awareness as to what these were. Concerns were expressed over industrial priorities as well as the relative allocation priorities between agriculture and aquatic habitat use. Improved public education was again suggested to increase awareness and dialogue.

Industrial water use raised further concerns that could be addressed through improved information and education. The public wants better information on potential future industrial water needs. Their concerns over the lack of information on groundwater/surface water interrelationships centres on industrial water uses. They suggest greater joint industry/government co-operation in providing information to the public. They would like to see a regular "State of the Environment" report rather than simply detailed statistics. Finally, they suggest development of a system that provides the public with a simpler means of lodging complaints to industry and of receiving satisfaction.

In coping with their concerns and needs related to water supplies and quality, the public must deal with many complex technical, institutional and regulatory systems. Improved information and education is a vital factor in reducing this complexity and minimizing water management problems.

All of the government departments and major industries involved in water-related activities have addressed the question of public awareness, information and education to varying degrees. Field staff are available in some regional locations, brochures on important topics are distributed, reports are printed and disseminated and public relations departments are established. Programs have been developed and people are active in the field. However, improvements need to be made both in the structures and in the focus of the programs.

To achieve what is being suggested, all the participants are going to have to work more closely together. Lack of communication or co-ordinated effort appears to be a shortcoming at the present time. There is going to have to be more information-sharing among departments and between industry and government. More attention has to be paid to linking with local administrators, a group which residents seem to be able to access relatively easily. Liaison will have to be established with the Department of Education.

Grass roots approaches to communication will have to be emphasized. Aggressive approaches to education are required: target the various groups in need, determine their needs and take the information to them in a form that is easiest for them to digest. When information is simply being made available, the providers must then be aggressive in informing the public of its availability.

The joint and co-ordinated activity that is being demanded by the public may require some new formal relationships among departments and with industry. "One-stop shopping" for information and the processing of complaints is a popular concept among northern residents. It would place novel demands on existing institutions.

6.3.1 Suggested Actions

At the conference, delegates discussed ways in which the public could acquire greater information and become better educated on water-related issues. These include:

- The public and government should work interactively. Government must find out what people need by asking them directly.
- Government should develop a "single-window" concept which would be capable of directing public inquiries to the proper organization or department.
- Improve public awareness of water-related information, perhaps through TV advertising.
- Government should hold more local workshops for regional concerns: workshops designed or tailored to handle local issues with input by the public.
- Government should encourage cross-cultural environmental awareness.
- Government should investigate using a 1-800 number as a public information line with a "one-window" approach.
- Each government program area should include an education component directed towards a targeted audience with an effective marketing strategy.
- Establish mandatory environmental education in school systems and promote a general public commitment not to take the environment for granted. Improve environmental awareness in the public school systems with presentations via mediums such as video, TV, literature. Provide courses for the public in layman's terms.
- Improve communication lines between local governments and industry. Develop hot-line services in industry for public queries and advertise its availability.

6.4 Policy Directions

A number of the actions suggested in Section 5.0 imply significant changes in policy direction at the provincial level. Foremost of these suggestions are adoption of water pricing, requirements for zero effluent discharge, and stipulation of no-net-loss in fisheries and wildlife habitat. A clarification and restatement of policy on interbasin transfers was sought by many participants in the pre-conference activities and previously discussed in Section 5.10. The intent in this Section is to highlight some of the implications of, and constraints to, adoption of water pricing, zero discharge, and no-net-loss. In a very real sense each of these policies has an economic dimension which will be drawn out in the discussion to follow.

Water Pricing

The concept of pricing water to encourage more efficient and effective use has been a popular notion for many years. In its review of Federal Water Policy the Pearse Inquiry Committee (Pearse, et al, 1985) strongly endorsed the principle "that beneficiaries should pay for water and waste-water services by means of appropriate prices." While pricing of water has proven to be attractive in principle and theory, the implementation of pricing implies a deviation from an array of existing practices where water supplies are provided to beneficiaries at less than the true cost. The pricing of water introduces a number of questions relating to the market value of water and methods of allocating water within a market system:

i) How would prices be established?
Alternative means include bidding or bargaining, costs of supply, costs of next best alternative.

ii) How would water be sold?
Options include the sale of rights for a predefined period of time or charges for water as used.

iii) Would water be allowed to be resold and could water rights be sold or traded?

iv) How would the quality of water be factored into price?

v) How would non-market uses of water (e.g., fisheries, recreation, esthetics) be protected where there is no obvious buyer or market for these uses?

vi) How would equity of pricing be assured? Would domestic well users pay a price as would industry?

vii) How would prices vary for withdrawal versus non-withdrawal or consumptive versus non-consumptive uses?

These questions illustrate some of the thorny problems which are encountered when attempting to implement water pricing. This is not to say that the problems cannot be overcome, but simply to indicate that implementation would require extensive prior research to ensure a workable system.

The interested reader is referred to two recent papers which provide an introduction to this topic (Mitchell, 1984; Millard, 1984).

Zero Effluent Discharge

Current provincial policy recognizes the "assimilative or self-purification capacity of watercourses ... as a natural resource that is legitimate to use" (Water Resource Management Principles for Alberta, Alberta Environment, 1983). The policy essentially reflects the position that some types and levels of wastes can be assimilated in the receiving ecosystem with an acceptable level of effect on that ecosystem.

A zero effluent discharge policy would set an objective of no effluent releases to watercourses or water bodies. This policy raises the basic question of how we handle "residuals" in our society. Few of society's activities are free of residual or waste streams and we, by necessity, must find means of recycling or disposing of these wastes. Moving away from disposal of wastes in watercourses implies the use of alternative disposal methods and the options in this regard are limited: on land, into the atmosphere through combustion, or released underground. Whether the recycling or alternative disposal routes are chosen, there may be a significant economic penalty for choosing these routes and environmental implications which may be equally severe as for waterborne disposal. The point made by many pre-conference participants was that they would like to at least have the technical and economic information before them in order to participate in decisions on policy regarding waste discharges.

No-Net-Loss Habitat Policy

The principle of "no-net-loss" in habitat has been adopted by the federal Department of Fisheries and Oceans with respect to fish habitat. The principle was suggested as a useful guideline for habitat conservation in Alberta. The policy as written implies that there are certain habitat losses which are unavoidable and that such losses can be compensated in kind through habitat rehabilitation and development. While currently restricted to fisheries, the policy may be equally applicable to waterfowl and aquatic furbearers. The policy refers to maintenance of productive capacity, a measurable characteristic of most aquatic ecosystems. Other values such as esthetics, recreation and groundwater recharge are not represented. The policy is intended to apply to degradation of habitat due to liquid waste discharges as well as physical disruption.

Although application of the policy might encounter problems in defining baseline conditions and actual productive losses, the no-net-loss concept appears to provide a sound guiding principle. Its application to waterfowl would, however, imply a sizable incremental effort for resource inventory, liaison with farmers and likely some form of incentive or compensation for costs of habitat loss mitigation.

6.4.1 Suggested Actions

Conference delegates discussed changes that could be made to water-related programs or program delivery. In these deliberations, they focused more on the operational than the policy dimensions of government programs and consequently, their discussions covered a wider field than the background observations of the consultants. The ideas for program changes include:

- There is a need for long-term co-ordinated planning: there seem to be a lot of programs that have conflicting goals.
- Program delivery needs to be equitable across the province and should be based on socio-economic needs. Residents in small northern communities have as much right to good drinking water and sewer systems as those in the south. The north should get the same funds for erosion and drainage as the south gets for irrigation.
- There need to be more interagency meetings to work together, not at cross purposes. Governments must tailor information to the people receiving it.
- Program delivery should be assisted through a facilitator who would interact between citizens and government. The facilitator would deal with citizens, communities and government.
- Conflicts between programs should be co-ordinated to resolve problems such as wetlands vs. agricultural drainage.
- There is a need for long-term co-ordinated planning to avoid conflicting goals. There should be a one-window approach with a contact person at the municipal level.
- Program delivery should meet the needs of the client and not the accounting system.
- Government departments' senior management functions should be restricted to program policy formulation, direction and monitoring, whereas program delivery responsibility should be as close as possible to the targeted client.
- Existing programs should be evaluated in terms of objectives and benefits, to

determine the allocation of funds. In addition, new projects must be evaluated in terms of costs and social benefits.

- Government should move toward single contacts for approving projects. The public now has to talk to too many people to obtain approvals.
- There is a need to simplify access to government and move project approval closer to the field.
- Government should provide incentives for the public to correctly install proper sewage systems, to follow proper procedures for abandoning wells, to undertake drainage/wetland conservation, and to enhance erosion buffer zones.
- There is a need for public funding assistance to improve individual and community water-related education, and to increase the awareness of existing water-related programs.

6.5 Research Requirements

During the research and public consultation process for this study, a number of areas were identified in which additional water-related research is required. This research and effective dissemination of its results to northern residents would help residents to understand more clearly the nature and extent of the water problems they are facing.

Little detailed information is available on the groundwater resources of northern Alberta. Consequently, complex problems related to withdrawals, contamination, the relationship between surface hydrology and groundwater cannot be adequately addressed. Further, little is known about supplies of potable groundwater.

Research priorities into northern groundwater resources should include:

i) the effects of drainage and forest clearing on groundwater recharge in specific areas of northern Alberta;
ii) problems with septic systems in northern climates and soils;
iii) identification of long-term potable groundwater supplies for northern communities; and
iv) groundwater/surface water interactions with emphasis on baseline groundwater inventory data.

Water quality and supply concerns with respect to aquifers for farm water supply also generate needs for research. Research is required into the effects of industrial withdrawals on aquifers and into methods to protect good quality aquifers from contamination.

Water quality concerns have also resulted in the identification of additional research needs. Concerns over non-point pollution sources indicate the need for research into natural farming methods using crop rotations, biological crop studies and green manure. Further research into the use of pesticides, herbicides and fertilizers related to specific crop types is also required. Workshop participants wanted the use of methoxychlor to be reviewed and the review is already underway by Alberta Environment.

Concerns over single-point pollution sources suggest the need for further research to reduce odor and color from pulp mill effluents and fish tainting from oil sands effluents. Emphasis on further research into recycling and other industrial and municipal treatment processes is also considered a high priority.

There are both concern and interest in expanding irrigation in northern Alberta but there is a lack of knowledge on the part of farmers with respect to appropriate standards, guidelines and related information on on-farm water supply systems for the north. To assist in decision-making, long-term agronomic and economic research on the feasibility of irrigation in northern Alberta is required.

Recreationists also pinpoint the need for additional research to enhance the resource base for leisure activities. Concerns over the possible effects of industrial withdrawals on lake levels identified further reasons to improve research into groundwater/surface water interrelationships. Recreation interests also point to the lack of inventory information on the region's fisheries resource. The need for a comprehensive inventory is considered a high priority to facilitate improved resource management.

Northern water and aquatic resources are increasingly feeling the pressures of population growth and industrial development. To effectively plan and manage these resources requires an adequate knowledge of the resource base and its current condition. Key information gaps exist and priorities must be established to guide further research in these areas. Budget allocations that reflect the priorities placed on research by northern residents would greatly improve the water resource knowledge-base for planning future economic development.

6.5.1 Suggested Actions

Delegates to the conference discussed the themes or areas that they felt needed to be emphasized in water-related research. Their suggestions include:

- Identify existing research activities and gaps so that high priority needs can be identified. We must prepare a detailed inventory of available research.
- All research should be assimilated by one group: a "one-window" agency approach.
- Involve the end-user in research projects to identify future research needs and to disseminate research information.
- Specific budgets must be set annually and funds dedicated to research on an ongoing basis. Funds should be obtained by application of the user-pay principle.
- Research results should be published and publicized annually.
- Adequate prior and ongoing research must be conducted before industrial or agricultural developments are undertaken, e.g., kraft pulp and paper mills, heavy oil, non-point sources, herbicides-pesticides, etc.
- Research is required on the impacts of land clearing.
- There is an urgent need for research on the fundamental interrelationships when water flow regimes are altered.
- There must be an adequate allocation or reallocation of funds to carry out the identified research requirements.

6.6 Budget Requirements and Resources

Many of the actions put forward to address water resource issues in northern Alberta will require significant incremental resources to implement. Others, such as co-ordination of roles, may be achieved within existing resource allocations. Exhibit 6.1 summarizes some of the major suggested initiatives which will likely require additional resources. In most instances, the onus for providing resources would fall upon the government of Alberta. In some cases, however, industry and local government, as well as public interest groups, would have a stake in seeing such actions implemented and therefore could be called upon to contribute resources as well.

The items noted in Exhibit 6.1 are cited as examples only. A comprehensive review of existing resources, and ways and means by which existing resources could be used more efficiently and effectively in fulfilling public needs, would be required before intelligent decisions could be made on resource allocations.

At this point, it is premature to put even rough estimates on the costs of implementing the suggested actions. It is clear, however, that those costs would be sizable. Within the current climate of fiscal restraint it is likely that hard decisions on priorities among the initiatives would be required.

Exhibit 6.1
Examples of Water Management Initiatives Likely Requiring Incremental Resources

Planning	• comprehensive integrated basin plans • extensive public participation
Monitoring and Enforcement	• increased field personnel capability for enforcement • increased water resource monitoring — particularly surface water quality and groundwater impact monitoring • enhanced laboratory and analytical capabilities
Information and Education	• co-ordinated thrust to inform and educate various sectors of the public • increased accessibility of public to environmental information
Program Delivery	• increased funding of drainage and erosion control programs • incentives for wetland conservation and greater effluent control • sustained or increased funding for community sewer and water facilities • funding for development of public infrastructure for increased tourism and recreation opportunities
Research	• increased basic and applied research in groundwater distributions and dynamics • increased research in methods of controlling waste discharges and increasing water-use efficiencies

6.6.1 Suggested Actions

Ideas from the conference delegates with respect to government funding for water management initiatives include:

- Determine the price tag of programs and projects discussed at the conference. Assess the amount of funding presently available and amounts that could be realized in the future.
- Available funding for projects should be allocated on the basis of economic viability but the economic evaluation must include the mitigation of environmental effects.

Appendix A

References Cited and Suggested Readings

Appendix A.1 — References Cited

Page	Citation
3-15	Alberta Environment, 1983, Cold Lake-Beaver River Management Study.
5-8	Alberta Environment, undated, Groundwater Licence Application Guidelines.
5-106	Alberta Environment, 1986, Water Recycling for In Situ Oil Sand Facilities — Guidelines for Applicants (Draft).
5-110	Alberta Environment, 1984, Water Use Study — Peace River Basin and Adjacent Northern Basins, Final Report.
5-110	Alberta Environment, 1982, Athabasca River Basin Water Use Assessment, Edmonton.
5-123	Alberta Environment, undated, *Water Resource Management Principles for Alberta*, Edmonton.
5-57	Alberta Environment, Pollution Control Division, 1984, Approach to Pollution Control — Environmental Enforcement Program.
5-41	Alberta Environment Conservation Authority, 1976, Erosion of Land in Northwestern Alberta: Report and Recommendations, Edmonton.
5-25	Alberta Utilities and Telecommunications, 1985, *Northern Alberta Small Communities Water and Sewer Servicing Study*.
5-117	Barton, B., "Water Resources and Native Peoples," Canadian Aquatic Resources, McHealey and P.R. Wallace, editors, Department of Fisheries and Oceans, Ottawa, 1987, p. 442.
5-123	Bocking, R.C., 1986, *Canadian Water: A Commodity for Export?* Prepared for the Rawson Academy of Aquatic Sciences.
5-122	Canada West Foundation, 1982, Nature's Lifeline: Prairie and Northern Waters, Calgary.
5-120	Day, J.C., 1985, *Canadian Interbasin Diversions: Inquiry on Federal Water Policy Research, Paper #6*, Simon Fraser University, Burnaby, B.C.
6-16	Millard, Frank W., 1984, The Role of Pricing in Managing the Demand for Water (published in Canadian Water Resources Journal, Vol. 9, Number 3, 1984).
6-16	Mitchell, Bruce, 1984, The Value of Water as a Commodity (published in Canadian Water Resources Journal, Vol. 9, Number 2, 1984).
3-12	Nanuk Engineering Ltd., 1985, Water Quality Overview of Athabasca River Basin, prepared for Alberta Environment.
5-26	Northern Alberta Development Council, 1980, *Review of the Northern Water Supply Program for Northern Communities Advisory Committee*.
3-25	Northwest Hydraulic Consultants Ltd., 1983, *Municipal Surface Water Supply, Peace River Basin*, prepared for Alberta Environment.
4-2	Pearse, P.H., F. Bertrand and J.W. MacLaren, 1985, *Currents of Change*, Final Report of the Inquiry on Federal Water Policy, Ottawa.

5-123 Scott, A., 1985, *The Economics of Water Export Policy: Inquiry on Federal Water Policy, Research Paper #7*, Department of Economics, The University of British Columbia.

5-16 Simco Groundwater Research Ltd., 1986, Regional Groundwater Assessment for Alberta Environment.

5-106 Somani, A.H., et al, 1987, Produced Water Treatment Technologies for Re-Use or Disposal (to be published).

Appendix A.2 — Suggested Readings

The following readings are suggested in order to provide more comprehensive information on the issue topics identified in Section 5.0 of the report.

General Readings

i) "To the Last Drop: Canada and the World's Water Crisis." 1986. Michael Keating. MacMillan of Canada, Toronto.

ii) "Water: The Emerging Crisis in Canada." 1981. H.D. Foster and W.F. Derrick Sewell. James Lorimer, Toronto.

iii) "Canada Water Yearbook." 1985 (and previous years). Environment Canada, Ottawa.
Available from:
Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9

iv) "Nature's Lifeline: Prairie and Northern Waters." 1982. Canada West Foundation, Calgary, Alberta.
Inquiries about availability of publication may be directed to:
Canada West Foundation
245 West Palliser Square
Calgary, Alberta
T2P 1K1
(403) 264-9535

v) "Federal Water Policy." Environment Canada, Ottawa
Available free from:
Enquiry Centre
Environment Canada
Ottawa, Ontario
K1A 0H3

1. Groundwater Management

i) "Management of Groundwater Resources in Alberta." Undated. Environment Council of Alberta, Edmonton, 45 pp.
Available free from:
Environment Council of Alberta
8th Floor, Weber Centre
5555 Calgary Trail Southbound N.W.
Edmonton, Alberta
T6H 5P9

ii) "Groundwater Issues: An Overview." 1985. J.A. Vonhof. Research Paper #14. Inquiry on Federal Water Policy, Ottawa.
Available free from:
Enquiry Centre
Environment Canada
Ottawa, Ontario
K1A 0H3

iii) "Groundwater." Environment Views. Volume 4, #2. June/July 1981. Alberta Environment. Edmonton.
Available free from:
Alberta Environment
Communications Branch
11th Floor, Oxbridge Place
9820 — 106 Street
Edmonton, Alberta
T5K 2J6

iv) "Groundwater Use in Canada." 1986. Paul Hess. IWD Technical Bulletin No. 140.
Available free from:
Inquiry Centre
Environment Canada
Ottawa, Ontario
K1A 0H3

2. Community Water Supply

i) "Municipal Water Works and Waste-water Systems." 1985. J.W. Macharen. Research Paper #3. Inquiry on Federal Water Policy, Ottawa.
Available free of charge from:
Inquiry on Federal Water Policy
Ottawa

ii) "Safeguarding Canadian Drinking Water." 1985. B. Groover and D. Zussman. Research Paper #4. Inquiry on Federal Water Policy, Ottawa.
Available free from:
Inquiry on Federal Water Policy
Ottawa

3. Farmland Drainage and Erosion

i) "Agricultural Land and Land Use Planning in Alberta: A Review of Planning Legislation and Practices." October 1981. Environment Council of Alberta, Edmonton, 77 pp.
Available free from:
Environment Council of Alberta
Edmonton

ii) "Water-Induced Erosion on Privately Owned Agricultural Lands in the Peace River Region: An Institutional and Legislative Analysis." 1975. W.E. Phillips, D. DePape and L.R. Brook. Environment Council of Alberta, Edmonton.
Available free from:
Environment Council of Alberta
Edmonton

iii) "The Erosion of Land in the Peace River Region." 1976. Public Hearings on Erosion of Land in Northwestern Alberta Information Bulletin No. 3. Peace River Regional Planning Commission, Grande Prairie, Alberta, 26 pp.
Available free from:
Environment Council of Alberta
Edmonton

4. Surface Water Quality

i) "Water Quality." Environment Views. Volume 6. # 5. September/October 1983. Alberta Environment, Edmonton.
Available free from:
Alberta Environment
Communications Branch
Edmonton

ii) "Alberta's Clean Water Act" (Conclusions and Recommendations of the Review of the Clean Water Act). March 1985. Environment Council of Alberta, Edmonton, 101 pp.
Available free from:
Environment Council of Alberta
Edmonton

iii) "Major Aquatic Contaminants: Their Sources, Distribution and Effects." Canadian Aquatic Resources, Canadian Bulletin of Fisheries and Aquatic Sciences, 215. 1987. R.D. Hamilton, J.F. Klaverkamp, W.L. Lockhart and R. Wagemann. Fisheries and Oceans Canada, Ottawa, pp. 357-426.
Available from:
Public libraries
or
Total Volume may be obtained from:
Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9
($20.00)

5. Watershed and Wetland Management

i) "Wetlands and Aquatic Resources." Canadian Aquatic Resources, Canadian Bulletin of Fisheries and Aquatic Sciences, 215. 1987. T.H. Whillans. Fisheries and Oceans Canada, Ottawa, pp. 321-356.
Available from:
Public libraries
or
Total Volume may be obtained from:
Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9
($20.00)

ii) "The Status of Wildlife Habitat in Canada: Problems, Issues and Opportunities." 1986. Wildlife Habitat Canada, Ottawa.
Available free from:
Wildlife Habitat Canada
1704 Carling Avenue
Suite 301
Ottawa, Ontario
K2A 1C7
(613) 722-2090

iii) "Canada's Wetlands"
Available from Energy, Mines and Resources, Ottawa, for $6.00 plus provincial sales tax.

iv) "Integrated Approaches to Resource Planning and Management." 1986. Reg Lang, editor. University of Calgary Press, Calgary.
Available from:
University of Calgary Press
Library Tower
2500 University Drive N.W.
Calgary, Alberta
T2N 1H4
($16.50)

6. Farm And Rural Water Supply

i) "Wells for Farm Water Supplies." Undated. Prairie Farm Rehabilitation Administration (PFRA), Agriculture Canada.
Available free from:
Agriculture Canada
PFRA Office
(various locations throughout the prairies)

ii) **Alberta Agriculture's Publication List "1985-1986"** lists publication on various topics relating to:

- **Dugouts for Farm Water**
- **Dugout Maintenance**
- Home and Farm Water Supply Manual
- Bacteriological Analysis of Farm Water Supplies
- Chemical Analysis of Farm Water Supplies
- Treatment of Dugout Water

Copies of the Publication List and the various publications can be obtained from:

Alberta Agriculture
Print Media Branch
7000 — 113 Street
Edmonton, Alberta
T6H 9Z9

7. Tourism, Recreation and Fisheries

i) "Recreation Sites in the Upper Peace River Valley." 1987. Alberta Forestry, Lands and Wildlife, Resource Evaluation and Planning Division, Edmonton.
Available on request from:

Alberta Forestry, Lands and Wildlife
Resource Evaluation and Planning Division
9915 — 108 Street
Edmonton, Alberta
T5K 2C9

ii) "Tourism North" (Conference Report — Peace River, December 5-7, 1984). 1985. Northern Alberta Development Council, Peace River, Alberta.
Available on request from:

Northern Alberta Development Council
2nd Floor
Provincial Building
9621 — 96 Avenue
Postal Bag 900 — 14
Peace River, Alberta
T0H 2X0

iii) "Tourism — Lac La Biche Country, A Study on the Tourism Industry in the Lac La Biche Region." September 1985. Regional Economic Development Council's Blueprint for the Future Committee.
Available on request from:

Travel Alberta
Development Branch
15th Floor
10025 Jasper Avenue
Edmonton, Alberta
T5J 3Z3

iv) "Grand Centre/Bonnyville Region Tourism Development Alternatives." May 1979. Marshall Macklin Monaghan Limited for Travel Alberta, Edmonton.
Available on request from:

Travel Alberta
Development Branch
Edmonton

v) Travel Alberta has sponsored a number of "Tourism Destination Area Studies." The following lists four for suggested readings:

- "Tourism Inventory and Assessment of Land of the Midnight Twilight." March 1983.
- "Mighty Peace Tourism Destination Area Study." March 1984.
- "Evergreen Tourism Destination Area Study." March 1984.
- "Lakeland Tourism Destination Area Study." March 1986.

Available on request from:
Travel Alberta
Development Branch
Edmonton

8. Industrial Water Use

i) "Produced Water Treatment Technologies for Re-Use or Disposal." 1987. A.H. Somani, A. Zaidi and V. Westlake. Monenco Consultants Ltd., Calgary, Alberta.
Available upon request from:
Monenco Consultants Ltd.
400, 801 – 6th Avenue S.W.
Calgary, Alberta
T2P 3W3

ii) "Canada Water Yearbook." Various years. Environment Canada.
Available at a charge from:
Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9

iii) "Environmental Issues/Water." Pamphlet. Canadian Petroleum Association, Calgary.
Available free from:
Canadian Petroleum Association
1500, 633 – 6th Avenue S.W.
Calgary, Alberta
T2P 2Y5

iv) "Industrial Water Allocation and Utilization in Alberta." Canadian Water Resources Journal Vol. 8, No. 4. 1983. J.P. Erxleben, and E.G. Hayes. Downsview, Ontario, pp. 20-34.
Inquiries about availability of publication may be directed to:
Edward S. Spence
Faculty of Environmental Studies
York University
4700 Keele Street
Downsview, Ontario
M3J 1P3

9. Native Peoples

i) "Water Resources and Native Peoples." Canadian Aquatic Resources, Canadian Bulletin of Fisheries and Aquatic Sciences, 215. 1987. B. Barton. Fisheries and Oceans Canada, Ottawa, pp. 439-465.
Available from:
Public Libraries
or
Total volume may be obtained from:
Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9
($20.00)

ii) "Special Issue: Legal Issues in Aboriginal Water Rights." Canadian Institute for Resources Law. Spring 1987. B. Barton. Paper #18, Calgary, Alberta.
Inquiries about availability of publication may be directed to the author at:
Canadian Institute of Resources Law
University of Calgary
2500 University Drive N.W.
Calgary, Alberta
T2N 1N4

10. Water Diversion

i) "Canadian Interbasin Transfer." Inquiry on Federal Water Policy, Research Paper #6. 1985. J.C. Day. Simon Fraser University, Burnaby, B.C.
Available on request from:
Environment Canada
Enquiry Centre
Ottawa, Ontario
K1A 0H3

ii) "Nature's Lifeline: Prairie and Northern Waters." 1982. Canada West Foundation, Calgary, Alberta.
Inquiries about availability of publication may be directed to:
Canada West Foundation
245 West Palliser Square
Calgary, Alberta
T2P 1K1
(403) 264-9535

iii) **"Canadian Water: A Commodity for Export." Canadian Aquatic Resources, Canadian Bulletin of Fisheries and Aquatic Sciences, 215. 1987. R.C. Bocking. Fisheries and Oceans Canada, Ottawa, pp. 105-135.**

Available from:

Public Libraries

or

Total volume may be obtained from:

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Ontario
K1A 0S9
($20.00)

Appendix B

Terms, Units and Acronyms

Appendix B — Units

The following flow rates and annual runoff volumes (discharges) are provided for comparative purposes.

Common units used in the study are also presented.

Approximate Average Flow Rates of Streams near the Mouths*

m^3/s		cfs
1-3	small prairie creeks	35-100
8	Qu'Appelle River	275
9	Battle River	320
15	Souris River	530
50	Assiniboine River	1 750
70	Red Deer River	2 475
100	Bow River	3 500
250	Red River (Manitoba)	8 825
2 000	North Saskatchewan River	70 600
10 000	Mackenzie River	350 000
2 000	Peace River	70 600
800	Athabasca River	28 240
25	Beaver River	875

* Average flows for any given year can vary significantly from these values.

Mean Annual Runoff

Location	Mean Annual Runoff (000 m^3)
Peace River	57.0 million
Smoky River and Watino	11.7 million
Peace River/B.C. Border	45.3 million
Peace River at Peace Point	66.3 million
Wabasca River at Waldon	3.8 million
Peace River Basin Alberta	21.0 million

m^3/s = cubic metres per second
1 m^3/s = 35.3 cubic feet per second (CFS)
dam^3 = cubic decametre (1 decametre = 10 metres)
= 1 dam^3 is a volume equal to 0.81 acre feet
= 1 cubic metre (m^3) is equal to 6.29 barrels
= 1 dam^3 = 1 000 m^3 = 1 000 000 litres
hectare = 1 hectare (ha) equals 2.47 acres
litre = 1 litre (L) equals 0.22 Imperial gallons
= 1 litre equals 0.001 m

Acronyms

AAMD&C	Alberta Association of Municipal Districts and Counties
AMGP	Alberta Municipal Grant Program
AMPLE	Alberta Municipal Partnership in Local Employment Program
AOSERP	Alberta Oil Sands Environmental Research Program
ECA	Environment Council of Alberta
EES	Environmental Evaluation Services
EPS	Environmental Protection Service
ERCB	Energy Resources Conservation Board
FDRP	Farmland Development and Reclamation Program
ICTC	Interdepartmental Committee on Toxic Chemicals
IRP	Integrated Resource Plan
NADC	Northern Alberta Development Council
NSF	Northern Supplementary Fund
PACE	Provincial Action Committee on Erosion
PFRA	Prairie Farm Rehabilitation Administration
RACE	Regional Action Committee on Erosion
RUP	Regional Utilities Program
SCAP	Soil Conservation Area Program
WMUP	Water Management Unit Plan
WRMS	Water Resources Management Services